THE

ELECTRICAL REVIEW.

VOL. XLI. DECEMBER 3, 1897. No. 1,045.

CONTENTS:

	PAGE
What is a Light Railway?	781
The Effects of Trades Unionism upon Skilled Mechanics	782
Lighthouses and Light-vessels	784
A Smooth-running Isolated Plant (*illustrated*)	786
Three-wire Practice in England and America	787
Marconi Telegraphy (*illustrated*)	787
Insulation and Cable Testing, with Suggestions for New Apparatus	789
American *v.* British	789
Regulation of Field Current in a Three-phase Generator	790
The Institution of Electrical Engineers	791
Electric Disturbance in Navy Yards	792
Correspondence:—Distribution of Electrical Energy	793
The Langdon-Davies Motor	794
Administration Report of the Indian Telegraph Department, 1896-97	794
The Langdon-Davies Motor (*illustrated*)	795
Legal	795
Business Notices, &c.	796
Notes	801
City Notes	804
Traffic Receipts	804
Share List of Electrical Companies	805
Reviews:—Block Signal Operation: a Practical Manual	806
Formulaire de L'Electricien	807
Mechanical Features of Electric Traction (*concluded*)	807
Some Superficial Notes on Swiss Power Transmission Plants, principally Polyphase, and a Comparison	809
Electrical Machinery at the Works of Messrs. Sir Christopher Furness, Westgarth & Co., Limited, Middlesbrough	811
The Economical Governing of Steam Engines (*illustrated*)	812
Proceedings of Societies:—The Physical Society	813
Siemens & Halske	813
Central Station Electric Coal Mining Plant in Pennsylvania, U.S.A.	814
The Engineers' Dispute	814
Parliamentary Powers	815
New Patents and Abstracts of Published Specifications	815

THE

UNIVERSAL ELECTRICAL DIRECTORY

(J. A. BERLY'S).

PRICE 6/- POST FREE.
The Leading Electrical Trades Directory and the Oldest Electrical Directory in the World.

1897.

PRICE 6/- POST FREE
Fully Revised and Thoroughly Reliable.
Contains a larger amount of Trade Matter than any other Electrical Directory.

H. ALABASTER, GATEHOUSE & CO.,
4, Ludgate Hill, London, E.C.

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON.

Telegraphic Address: "AGEEKAY, LONDON." Code A B C.
Telephone No. 933 Holborn.

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades.

SUBSCRIPTION RATES.—In *Great Britain*, Post Free per Year, 19s. 6d. To *all other countries*, per Year, £1 4s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each.

READING CASES, to hold from One to Twenty-six Numbers until the Volume is complete for Binding, can now be had from the Publishers, Price 6s. or Free by Post (in Great Britain), 6s. 6d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. *Paris:* VEUVE J. BOYVEAU, 22, Rue de la Banque. *Berlin:* ASHER & Co., 5, Unter den Linden.

Cheques and Postal Orders (on Chief Office, London) to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill E.C.

WHAT IS A LIGHT RAILWAY?

ENIGMAS of the genuine order are good enough for early civilised periods, just as the nigger conundrum serves nowadays as an instance of the lowest forms of alleged wit, so that despite the near approach of Christmas time, when chestnuts are roasted as well as trotted out, it is hardly to be wondered at that the Board of Trade does not seem to relish being called upon to answer such a poser as that which forms the title of these remarks.

As many men of no more than ordinary clearsightedness or ability pointed out when the Light Railways Act was passed, the total absence of any definition of a light railway, or even strict delimitation of its sphere and characteristics, made it absolutely certain that some amount of confusion would arise, while not the least surprise ought to be felt at those interested in tramway development making use of the new powers to further their projects.

Many no doubt regard the Light Railways Act as a thoughtful kind of unofficial backdoor to the securing of powers for the countless new and extended tramway lines which ought to be built in this country and operated by means of electric traction on the newest systems.

It therefore comes upon the tramway world as somewhat of a shock and back-handed blow to find out now that the Board of Trade seems inclined to frown upon such efforts to secure a reasonable standing for tramway enterprise, and to lay down in effect that light railways are in effect to be interurban lines, or those connecting up outlying districts with a town or thickly populated centre.

Of course, tramway promoters ought perhaps to have borne in mind that it never pays to take anything for granted, most of all with a State Department, whose dignity or standing is such that its consent to any particular mode of action must not be lightly assumed; but in view of the results, no one can blame tramway men for trying to pass through the back door, when the only condition of getting in at the front is to pay through the nose and enter into a species of servitude—all work and no reward.

Tramway matters have, indeed, now reached such a pass, that if any more development is to be seen, and the enormous advantages of electric traction secured to the country at large, either new lines and extensions of old ones must be sanctioned under the Light Railways Act, or else the Tramways Act of 1870 must be repealed or altered in such fashion, that while duly safeguarding the interests of local authorities and municipalities, a reasonable field shall be opened for private enterprise in tramway work.

Perhaps we may feel a "modified rapture" in the thought that even though the Board of Trade should maintain its present attitude of correcting the naughty tramway boys (who have tried not so much to sneak into an orchard round the back way for the sake of getting ripe apples, but who have desired rather to make sure of a chance to help dig the garden first, so that the apples may grow ripe by and by),

yet the matter will have come so markedly to the front, that further action cannot be delayed. But what a saving of time and trouble if the limitations of light railways had been set forth earlier in the year, so that tramway men might have known at once whether any efforts on their part to obtain powers under the Light Railways Act would be futile or not!

Possibly the Board of Trade is like the "coy" maiden who long ago said "yes" in her heart, but wishes to be assiduously courted, and her gracious consent formally asked, before giving way. We trust, at any rate, that one solution or the other of this vexing problem will soon be reached, so that tramway affairs may go ahead with far more ease and rapidity than hitherto.

THE EFFECTS OF TRADE UNIONISM UPON SKILLED MECHANICS.

If we are to judge by the stream of articles now appearing on the question of interference with production, we should say that the grievance has been much felt for a long time, but has not been voiced. But interference now seems tottering to its fall, and everyone appears to be fully alive to the absolute need for the complete amputation of this mischievous limb of trades unionism. Mr. Hiram S. Maxim discusses the subject in the pages of the *Engineering Magazine*, and shows how he has felt the pinch. We believe that Mr. Maxim is correct when he states that the unions seek to specialise work by preventing a man from learning more than one thing. We cannot understand why they take this attitude. The reduction of a man to a mere automatic machine has always seemed to us one of the most serious objections that could be raised against an employer's policy of getting all he could out of a man by keeping him at one thing all his life, and letting him learn nothing else. Yet it is the men's own selves who, in the shape of the union, do this evil thing. A one-job man has a poor chance of finding other employment when idle. Mr. Maxim instances a man who left the union rather than be barred by it from doing anything he chose to do. In making his guns, Mr. Maxim had certain drop forgings made as closely as possible to finished size, so as to just clean up in the milling machines, a margin of $\frac{1}{32}$-inch being left. When a Union man got charge of the work, he enlarged all the drop dies, so as to make more work in milling down. On discharging the man, and putting on a non-Union man, the dies were reduced, but when sent to a German factory to mill, the complaint was there was still too much metal to cut away. Similarly, when Union men did the milling, they left pieces much too large, so as to give the fitter something to do in filing down, though it is well known to be possible to mill guns and pistols so closely as to permit the finished articles to be put together without any fitting.

In France, Mr. Maxim found girls working six machines on heavier cuts and at higher speeds than could be got out of the one man one machine system at Crayford. Later, he found these same girls were working no fewer than 18 machines. Apart from the dawdling now so common, and which manifests itself in the stopping of a lathe to grind a tool, and the loss of several minutes at starting in the morning, in place of having the lathe start with the engine, it is the author's opinion that Trades' Unions have a very bad effect upon the development of skilled mechanics. To put it in Mr. Maxim's way, the Unionist does not think, but it appears to his clouded intellect that there is a fixed quantity of work to be done, and therefore work must be nursed, or it will all get finished up.

Now Mr. Maxim just hits the nail on the head in this remark. It has been urged against the Electrical Review that our articles on the strike are too strongly expressed, and even agressive. We are but human, and the spectacle of the fine fabric of English industry slipping away to ruin, and an absolute conviction that nothing but the exercise of a little common honesty is needed to maintain it, is sufficient, we trust, to excuse any lapse from the strict line of propriety. Mr. Maxim says that Trades Unions oppose, and always have opposed, the use of machinery which enables work to be turned out quickly and cheaply. This is the spirit at the bottom of the whole question of interference, and there can be not a shadow of doubt that a severe blow has been dealt at this system. We observe that even Mr. Barnes now disclaims any intention of interfering. It is possible we have done Mr. Barnes an injustice; it is possible he has not been aware of the wide extent of the evil. He knows it now, and it has cost the country several million pounds to convey the intelligence to the mind of the one man who has had to bear the blame of something he does not desire shall take place.

Generally, Mr. Maxim's article is but another of the vast number of assents to the contention that interference of a grievous kind has taken place. One of his own workmen calculated that if the Crayford workmen did as much work as the French girls he was taken to see in Paris by Mr. Maxim as an object lesson, the 300 men at Crayford would be reduced to 60, and the rest would starve. This idea of men starving because work is cheaply done has been the dominating factor ever since the days of the Luddites. It is a specimen of the perennial short sight which afflicts all men not trained to habits of thought and study. The fallacy has not been negatived by accumulated experience to the contrary. All the cotton mills of Lancashire to-day make no appeal to the mind of the engineering trades unions. They probably have never read of Hargreaves and Halli'th'wood, where he hid his frame, and if they have they will not be able to parallel the simile. England to-day does not so much require technical education for her artisans as a broader classical education; it is want of this that has caused the present strike and changed the composition of the executive of the A.S.E. to what it is to-day. If all men were educated so as to have even an elementary knowledge of commercial economy, we fancy they would be better able to form correct judgments upon such subjects as hours, wages, foreign competition, and other vexed questions. This want of knowledge is not confined to the so-called working classes only. The general public are in a very similar case. Only a few days ago we encountered a man holding some position in a bank. He seemed to have a strong leaning to the eight hours' demand made by the engineers, and we discovered that he was under the impression that engineering shops were conducted like banking establishments, every man having a given job allotted him for a day, which had to be finished that day, in the way bank clerks have to balance up every

evening. When he was correctly informed, and discovered that the whole trouble was really opposition to machinery, he entirely changed his opinions, for he knew perfectly well the folly of the men's attempt, and could see that they were simply injuring themselves and the country.

Subterranean Rivers.

In the November number of the *Geographical Journal* we find a communication from Sir Clements Markham, who describes how Baron Nordenskiold reasoned out the possibility of finding fresh water by boring strong hard crystalline rock. Baron Nordenskiold's idea was that by boring through the granite rocks he would strike water-bearing fissures. He therefore selected the rocky islets on the Swedish coasts which serve as pilot and light stations, and completing borings found that sweet water could be obtained at a depth of 100 feet, the texture of the surface rock preventing the salt water from percolating through and comingling with the sweet water lying in the fissures. In the same number of the *Geographical Journal* there is an article by M. E. A. Martel on "British Caves and Speleology." M. Martel describes a descent into caves near Enniskillen, as well as other descents in Ireland, and also describes what he saw of underground rivers and lakes in Derbyshire and in Yorkshire. In the case of the Irish caves he says their flowing waters must have an outlet under the sea, as there is no other way to account for the phenomenon. We refer to these matters as they interest cable engineers, and bear upon a paper read before the Institution of Electrical Engineers during last session by Mr. Benest. In this paper our readers may remember it was stated that it was believed by some engineers that submarine telegraph cables when laid on a continental slope, and in a direction more or less parallel to the coast line, were liable to interruption from the effects of an outburst of subterranean water on these slopes even in deep water. Deductions from the evidence furnished by Baron Nordenskiold and M. Martel seem to increase the belief in the theory referred to in Mr. Benest's paper.

Ozone Generators.

An interesting note was recently communicated to the London Section of the Society of Chemical Industry on the subject of "Ozone Generators," by Edward Beanes. This note was suggested by Mr. Andreoli's paper on "Ozone: Its Commercial Production," upon which we commented some time ago. Mr. Beanes is well known as an old worker in this difficult field. For the commercial application of ozone, Mr. Beanes considers that the generator with glass plates which was introduced years ago by him, will appear to be the only way, so far as can be at present seen, to obtain a large area. Point-bearing electrodes have been advocated, but experience has shown him that points should be avoided. For the successful production of ozone, the electrodes should be as highly charged with electricity as possible, but such charging cannot be adopted with point-bearing electrodes because sparks would be produced, and ozone, already formed, would be destroyed. With very highly charged electrodes (most conducive to ozone formation) even specks of dust or dirt might give rise to sparks through the formation of points. The only way to avoid sparks with point-bearing electrodes is to avoid charging these electrodes so highly as to reach the sparking point, but this would be at the sacrifice of capacity for the production of ozone, yield would be greatly diminished. The air to be ozonised should be dried and filtered through cotton-wool, otherwise small solid particles may become deposited on the electrodes, and sparking may ensue, as already explained. There is doubt that nitrous vapours would be formed as the result of sparking, and with these a peculiar odour, but ozone would be destroyed. Looking at the character of a large number of so-called chemical patents annually issued, it is not impossible that the conditions laid down in sundry of those patents, ostensibly for the production of ozone, will rather favour the formation of oxides of nitrogen—in other words, of nitrous fumes.

Electrical Omnibuses.

The statements made at a meeting of shareholders of the London Omnibus Company, which is briefly reported in another page, cannot be considered in the least degree reassuring. They are all the more alarming because in the main they are incontrovertible. Without attempting to transfix the directors with the statements made in the original prospectus, attention might very properly be called to the remarks made by the chairman at the statutory meeting of the company held in September of 1896. They had the bus nearly ready and it would be the most comfortable ever seen, and they were going to complete more of these omnibuses and put them on the streets. There would be practically no vibration and hardly any noise. On the two latter points the company may be held to have proved their case, for there has been certainly no vibration, and there has been exceedingly little noise. There can be no doubt, however, of the seriousness of the company's position. The company was formed as "a sound progressive industrial British enterprise" (we quote from the prospectus), in May, 1896, to take up what was termed Mr. Radcliffe Ward's system of street traction, which had been successfully investigated and experimented upon. Eighteen months have elapsed since that statement was made to the public, and not a single *bonâ fide* passenger has yet travelled in an electrical omnibus.

The Headland Electric Motor Car.—The mail phaeton which we illustrated in our issue of November 12th, is the first carriage made by the Headland Patent Electric Storage Battery Company, Limited, of 12, Pall Mall, and it has been running experimentally during the past nine months. It is the carriage that took part in the Lord Mayor's Show this year. The carriage weighs about 23 cwt., and is constructed to carry four persons. The batteries consist of 40 cells, weighing 11 cwt., and will propel the carriage a distance of about 50 miles. The capacity of the cells is 150 ampere hours, whilst the charging rate is 30 to 40 amperes, and the normal discharging rate 25 amperes, though the cells have—for short periods—been discharged, when climbing steep hills or from other causes, at about 130 amperes without injuring them in any way. There is no clumsy appearance of machinery. The motor is suspended from the body of the carriage, and secured by a frame pivoted at one end to the axle in such a manner as to compensate for the motion of the carriage springs. The rear axle is driven by bevel gearing, the ratio being 9 to 1. For the steering a pinion gearing is used, with a quadrant rack on the fore carriage. The starting lever has three positions, and the speed is regulated by grouping the 40 cells in four sections, these being arranged in three ways, viz.:—(1) the four in parallel; (2) two parallel groups, each having two sections in series; or (3) the four in series. The motor is 4 H.P., and is series wound. The car is fitted with two brakes—one a hand brake on the axle, and the other a hand brake on the wheels. The speeds on the level road are respectively three, seven, or 15 miles an hour. The cells have been subjected to the severest tests, and are said to have proved themselves suitable for traction work, which involves sudden high rates of discharge.

LIGHTHOUSES AND LIGHT-VESSELS.

The fifth and Final Report of the Royal Commission on Electrical Communication with lighthouses and light-vessels has recently been issued as a Parliamentary Paper. The Royal Warrant by which the Commission was appointed directed (1) that inquiry and report be made what light-vessels and lighthouses it is desirable should be connected by electrical communication, and (2) that suggestions should be submitted as to how such communication should be established. The Commissioners have therefore completed their task, and in submitting this, their Final Report, to Her Majesty, they consider that they have complied with the first of the two requirements demanded of them, so far as it was possible to do so, without prolonging their inquiry indefinitely.

Speaking generally, the Commissioners are of opinion that where lighthouses and light-vessels which were recommended in their first three reports, and on pp. 8 and 9 of the present one, have been connected, the stations at which the most urgent needs were and are felt for electrical communication, will have been dealt with, keeping in view the practicability of establishing and maintaining such communication in a satisfactory manner and at reasonable cost. They trust, however, that the work will be carried on steadily in the future, and that provision will be made therefor by the Departments of State interested, and the Commissioners indicate, on a subsequent page, the general lines which, it appears to them, should be followed in selecting stations to be connected.

As to the methods of communication, no difficulty, it appears, has been experienced in deciding upon the manner in which electrical communication should be established with the shore lighthouses selected.

In the case of most of the rock lighthouses, it is found that communication can be successfully effected by means of continuous cables, except in the case of one of those stations, viz., the Fastnet, in which case the Commissioners considered it necessary to suggest the employment of a non-continuous system of telegraphic communication.

The difficulties which have been met by the Commission in its endeavours to find an efficient and reliable system of electrical communication with lightships have, it is stated, been more serious.

The list of light-vessels, as set forth, which have been connected electrically with the shore on the recommendation of the Commission, is as follows, viz :—

East Coast of England.	West Coast of England.
Goodwin (North Sand Head).	Formby.
Kentish Knock.	
Shipwash.	
Hasboro'.	

(Five in all.)

On referring to the First Report issued December 8th, 1892, we find that it was recommended that the *Goodwin* (North Sand Head), the *Kentish Knock* the *Shipwash*, the *Hasborough*, and the *Scarweather* light-vessels be immediately connected, and that the employment of the telephone be adopted to these five communications. Although the *East Goodwin* was not included in this recommendation, this light-vessel was regarded as one of the most important, on account of the enormous extent of the passing trade, the number of casualties that had occurred within visual range of it during a period of 10 years, and the commanding position which it occupies over the Goodwin Sands, and the shipping in the Straits of Dover. The distance of this light-vessel from Kingsdown is less than 8 miles, and the estimated cost of installing the cable and land wire was £2,100. The difficulty in establishing communication is said to be owing to the depth of water the lightship is moored in, which is close on 30 fathoms.

In view of this strong recommendation of the Commission expressed in their First Report, and emphasised in the Final Report now before us, it is to be hoped, as is suggested, that the Trinity Board will see their way to provide a larger vessel for the station, for the position is, as the Report states, a commanding one, and casualties are more likely to occur within visual range of it than of the other two, the North Sand Head and the South Sand Head light-vessels. The east side of the Goodwin Bank is very "steep to," there being from 7 to 12 fathoms at the edge, consequently a most dangerous shore in case of a vessel getting close in during thick weather with an easterly gale and a heavy sea. The North and the South Goodwin light-vessels, situate each of them at nearly 7 miles from the East Goodwin, would be unavailable as signal stations to call for assistance to a wreck which might be within sight of the East Goodwin, and we cordially endorse the views of the Commissioners with respect to this important station.

With regard to the *Scarweather* light-vessel we do not notice that the Commissioners in their First Report of December, 1892, made any reservation in their recommendation that this, with the other vessels named, should be immediately connected, beyond the statement that the vessel on this station did not belong to the newest class and would probably have to be replaced by a more efficient one, if electrical communication were to be effected. The depth of water where the vessel is placed is 14 fathoms, with a sandy bottom affording good holding ground. The *Scarweather* lightship is stationed off the northern shore of the Bristol Channel south of Swansea Bay, and marks the dangerous shoals known as the Scarweather and Nash Banks, which extend seven miles from the land. The Report states that the trade passing the vicinity, converging as the Channel narrows, is very large, and casualties are frequent. The cost of connecting this station was estimated at £2,145, not a prohibitive sum, and only £45 more than the estimate for the East Goodwin. The connecting of the Kentish Knock was estimated at £3,575. The position of the *Scarweather* as the sentinel of Swansea Bay and the leading light for clearing the perilous Nash Sands, is equal in importance to the *Kentish Knock* light-vessel in the estuary of the Thames, or to the *Goodwin* light-vessel to the north of those sands; so that the *Scarweather*, together with the East Goodwin light-vessels, certainly stand first among the others named in the claim to consideration; the Cross Sand, the Kish, the Tongue, and the Sunk light-vessels following in order.

In the preliminary remarks of the Third Report, April 26th, 1895, the Commissioners say that "Effect has now been given to all their recommendations previously made in the two reports already issued, except in the case of the *Scarweather* lightship, and Caldy and Fastnet lighthouses, and that they assume that the connection of those stations will shortly be taken in hand. This is now two-and-a-half years ago. In the case of the lighthouses, the promise has been fulfilled, but the lightship named is left pending results of experiments in the ethereal system at present under trial. However, we venture to hope now that little time will be lost in bringing the two floating stations we have here specified into electrical touch with the shore, and that the others will meet with attention in detail without waiting for developments of a problematical character.

We further note with surprise that in the schedule of recommendations, p. 12, the Commissioners have not included the *Scarweather* among the other light-vessels, they have specifically mentioned under the head of recommendations on p. 9. This may be due to a slip, but it has the effect of reducing the estimated total cost which, by including the cost of the *Scarweather*, should be £12,205 instead of £10,060.

Upon referring to the Second Report of the Commission, we note that particulars of a number of inventions for effecting electrical communication between light-vessels and the shore had been received. Among these there were surely some that might have met with more than a passing condemnation, and it seems to us incomprehensible that no improvement could have been devised upon the so-called "Sunk" system, which was discarded after a two years' trial in 1896 at the light-vessel of that name.

In the Third Report, page 1, issued April 26th, 1895, we note that the Commissioners state they think it is desirable a trial should be given to a system of communication by induction, in order that they may be able to judge before issuing their final Report whether such can be used. In the Fourth Report, page 7, concluding remarks, it is stated that this induction system has not yet been subjected to a practical test at a lightship, but it is regarded as offering greater chances of success than any other invention of the same nature that had been submitted. This system of telegraphy by induction was to have been tried in the first instance in establishing communication with the East Goodwin light-

ship, but for sufficiently cogent reasons, we suppose, this intention was whittled down to a simple experiment carried out in August, 1896, at the Goodwin (North Sand Head) lightship, but at this station it was found impossible to effect communication through the water, the electric energy being almost entirely lost in the sea.

In the present and Final Report, it is stated that on the failure of this experiment attention was directed to a system of signalling through the ether without wires. Experiments, it is stated, had proved very satisfactory, communication being obtained without the aid of intermediate wires between two points on either side of the Bristol Channel nearly nine miles apart.

Mr. Preece's sentiments towards these rival methods of induction might well be expressed in the words of the song, "How happy could I be with either, were t'other dear charmer away!" but we would venture to suggest that "'tis well to be off with the old love before taking on with the new." As to the novelty of this aerial induction method of signalling, it appears to be open to question, many experimenters in this direction having already been in the field.

As to this promised new method of effecting electrical communication with light-vessels, we must confess to a pardonable scepticism, and we are inclined to believe that it will come to about the same in the end as the aqueous induction system as applied to lightships, from which such promising results were expected a year or two ago, both here and on the North American coast.

In referring to the recommendations set forth in the First Report of the Commissioners in 1892, we find that the *Formby* light-vessel was not included therein, but in the Third Report, April 20th, 1895, it is recommended, in consequence of representations made to the Commission by the Mersey Docks and Harbour Board, that this light-vessel be connected by means of the "Sunk" system. This connection was effected on the 20th October, 1895, since which there have been four breakages, one of which is tabulated as an accident not attributable to any defect in the system, the rest were through the chafing of the veering cable in the vicinity of the swivel, no damage at all having been experienced through the threshing of the veering cable on the bottom, nor through the formation of kinks in the veering cable. This speaks well for the special type of veering cable used at the *Formby*, and we think that the chafing might be diminished greatly if not altogether avoided, by improving the conditions under which it exists in the neighbourhood of the swivel.

The subjoined table shows the causes of the several breakages of the electric cables to the five light-vessels with which electrical communication has been established, from the time the cables were first laid to the end of 1896:—

Light vessel.	Cause of breakage.				
	Total No. of breakages.	(*a*) Accidents not attributable to any defect in the system of connection used.	(*b*) Formation of kinks in the veering cable.	(*c*) Threshing of the veering cable on the bottom.	(*d*) Chafing of the veering cable at or near the swivel.
Kentish Knock ... (Connected Mar. 14th, 1894.)	11	4	1	5	1
Goodwin (North Sand Head) ... ... (Connected Mar. 24th, 1894.)	5	2	...	3	...
Hasborough ... ... (Connected 2nd, Oct., 1894.)	5	1	2	2	...
Shipwash ... ... (Connected 17th Nov., 1894.)	2	...	...	2	...
Formby ... ... (Connected 20th Oct, 1895.)	4	1	...	...	3
Total	27	8	3	12	4

In regard to breakages generally, these appear to occur in the veering cable, from various causes, at all the vessels alike, the *Kentish Knock* heading the list with 11 since she was connected in March, 1894, four of these breaks not being attributable to any defect in the system of connection. According to the foregoing classification table from the Final Report, breakages due to defects in the system are limited to three kinds, viz., the formation of kinks caused by vessel swinging round with wind or tide; (*b*) the threshing of veering cable on the bottom owing to the movement of the vessel; (*c*) and the chafing of the veering cable at, or near to, the swivel to which the vessel's mooring chains are attached, and through which the cable has to be passed before entering the vessel; (*d*) with regard to the second cause this liability to accident might be altogether avoided by the adoption of some automatic method of keeping the cable in its normal condition of twist. In their final report the Commissioners state that owing to want of experience on the part of the men, the drum had been in some cases turned in the wrong direction, with the result that instead of a turn being taken out another turn was put in. As to the third cause of injury this cannot be avoided entirely without changing the form of the vessel, but it could, we venture to suggest, be minimised greatly by adopting a suitable type of veering cable, such as that used in the *Formby* connection, no accident having occurred due to this cause since its establishment over a year ago, which is more than can be said in regard to all the other vessels connected, the *Kentish Knock* leading with five breakages under this head.

In their consideration of this branch of the subject, the Commissioners do not appear to have taken sufficiently into account the pressure of the tidal movement of water against the cable, this sets up a constant vibration which, in addition to causing constant attrition at the bottom, produces a "hammering" effect of the cable on the inside of the swivel, a partial remedy has, we believe, been devised for this in reeving on the veering cable greenheart wood ferrules made to exactly fit the bore of the swivel.

Chafing of the veering cable in and near to the swivel should be amenable to cure, for, excepting as against the Kentish Knock, which appears to possess the most restive craft of the lot, and the Formby, there are no entries in this column. A better safeguarding of the veering cable in proximity to the mooring chains and in the "bore" of the swivel is desirable.

The suggestion of the Commissioners to the departments interested in the question that one of the crew of a light-vessel should be trained to effect repair is good so far as it goes, but why not allow others of the crew to qualify in this direction—there is a smack of exclusiveness in thus confining knowledge of a particular subject to one branch of the service. To quote an old saw, two heads are better than one, and the more the men composing the lightships' crews are encouraged to take an intelligent interest in this work, the more the chances of further improvement in small but important details.

It would have been interesting if the Commissioners had enlarged just a little upon some of the several proposals "which have for their object the prevention of damage caused by the threshing of the veering cable on the bottom," *vide* Fifth and Final Report, p. 5, also of the numerous inventions spoken of in previous Reports. The Commission should not have kept all this valuable, or otherwise, information bottled up. Why should not all interested have an opportunity to judge whether a judicious as well as a judicial conclusion has been arrived at. It would also be instructive to know something about the experiments that the Submarine Department of the Post Office has been engaged in, with different types of veering cable with a view "of adopting one which will live longer under adverse circumstances than those at present used." Perhaps the edges of the swivel may be responsible for the failure of some one of these types of cable, and we note with satisfaction that the Commissioners have suggested some alteration in the form of the swivels to be used in future.

Regarding the conclusion of the Commission, that any alterations in the apparatus by which electrical communication is established under the "Sunk" system, will not effect such improvement as to render it possible to maintain reliable connection at a small cost with light-vessels exposed to very heavy weather, and that it is impracticable to connect by that system vessels like the *East Goodwin* and *Cross Sand* lightships, we would say. Try another plan. Large

sums of money have been spent in experiments during the labours of the Commission. Notably one referred to lately by Mr. Preece as a costly attempt to communicate between Ramsgate and the Goodwin lightship by the Eversheds method of induction last year, and which cost something like £1,000, leaving little or nothing to show for the money. It was owing to the failure of this experiment that the Commission turned its attention to electrical communication by wireless telegraphy, and it is stated that experiments in this direction have proved very satisfactory, insomuch that the Commission does not consider it necessary to defer issuing its Final Report until the trial of this system at a lightship is known, so that its further development is left to the care of the Departments of the State into whose province it now falls.

(To be continued.)

A SMOOTH-RUNNING ISOLATED PLANT.*

The accompanying illustrations refer to an isolated lighting plant recently installed under conditions somewhat exceptional in character. The plant was put in by the firm of J. Manz and Co., engravers, Chicago, to be used for driving their power plant, lighting the workshops, and generating the necessary current required in their business. After due consideration the Ideal engine, manufactured by A. L. Ide & Sons, Springfield, Ill., was purchased, on account of the many superior features which this engine possesses, including reliability and smooth

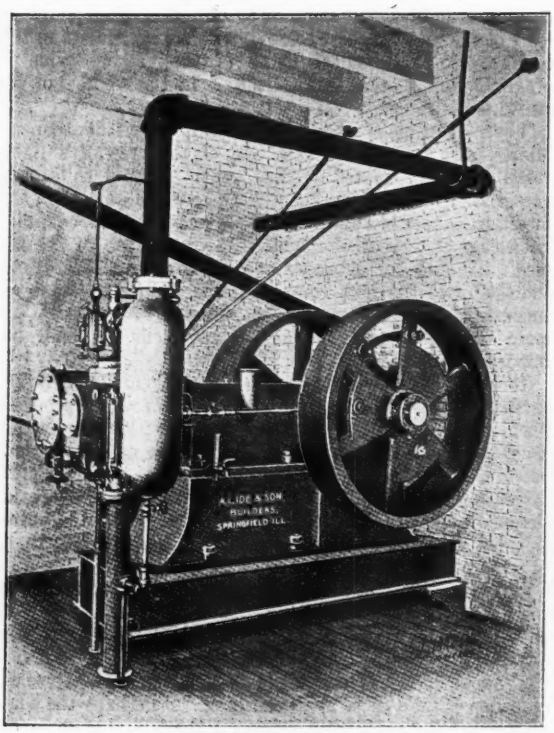


Fig. 1.

running. The unit consists of a 13 inch × 12 inch latest type of Ideal engine, located on the seventh floor of the building, and the purchaser was given a guarantee that when carrying its rated capacity it would operate noiselessly, and without vibrating or shaking the building, or causing any annoyance to the tenants of the building.

The method of securing this engine originated with the builders, and will be readily understood from fig. 2, shown on next page. The engine is located as close to the wall as possible. This wall is about 2 feet thick, and a small casting with a face 21 inches long is secured to it by a 1¼-inch bolt. On the face of this casting are placed two girders or T-rails, which are bricked into the wall and bolted to same. These bolts extend through a clamp 1½ inches thick by 3 feet 6 inches high, and are securely fastened. The girders extend the entire length of the engine sub-base, and are located so that the bottom edge is 6 inches above the floor line. After the engine was located in its proper position, two ⅞-inch bolts were off-set and connected with two eye-bolts, extending through the brick wall, and connected to the engine by means of an eye-bolt securely fastened to the engine frame. The tension on the bolts, that is, between the eye-bolts in the wall and the eye-bolt on top of the engines, is governed by means of a swivel nut. When in position, the distance between the eye-bolts in the wall is about 6 feet.

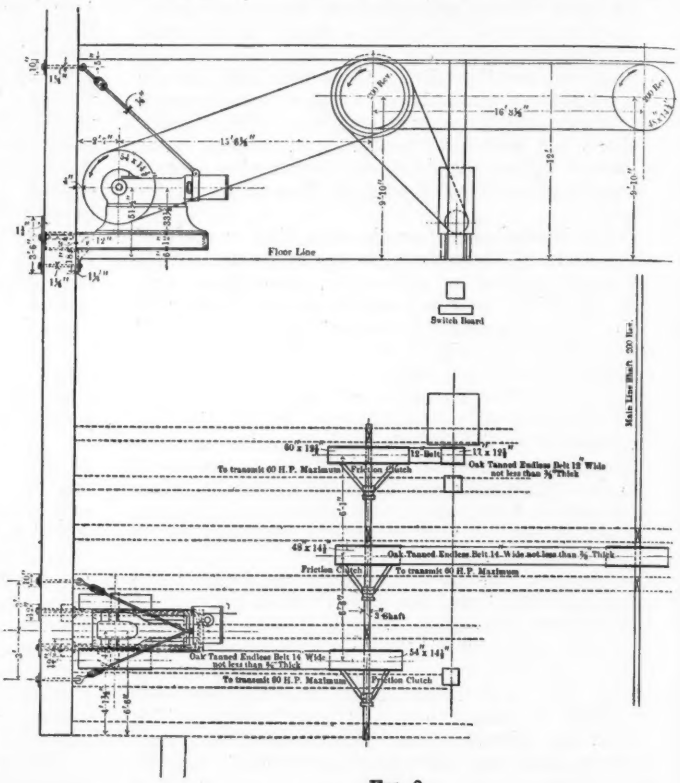

Floor Line
Switch Board
Main Line Shaft 200 Rev.
To transmit 60 H.P. Maximum
Friction Clutch
Oak Tanned Endless Belt 12" Wide not less than ¾" Thick
Oak Tanned Endless Belt 14 Wide not less than ¾ Thick
To transmit 60 H.P. Maximum
Friction Clutch
3" Shaft
Oak Tanned Endless Belt 14 Wide not less than ¾ Thick
To transmit 60 H.P. Maximum
Friction Clutch

Fig. 2.

The steam used for driving the engine is generated in the basement of the building, and to protect the engine from water, it is equipped with an ideal steam separator of the latest improved type. The engine is balanced so perfectly, that when in operation and carrying its rated load, there is not a particle of vibration, and the tenants on the floor below do not know when the engine is in operation or when it is shut down, so noiseless is its operation. The power is transmitted from the engine by a 14-inch belt to a countershaft, and the countershaft is connected to a main shaft by another 14-inch belt. There is a friction clutch on this countershaft, so that the engine can be thrown into service or cut out at any time desired. There is also a 40 kw. latest improved National Electric multipolar dynamo, connected to the main line shaft operated by this engine.

* *American Electrician.*

Electrical Engineering in Italy.—An electric power transmission plant has just been installed at an asphalt works at San Valentine, near Chilti. The water power of the River Pescara is utilised, the generating plant comprising a large turbine and a tri-phase dynamo. The power is transmitted to the works over a distance of 3 kilometres and actuates two motors, one of 5 H.P. and one of 50 H.P.

THREE-WIRE PRACTICE IN ENGLAND AND AMERICA.

By HAROLD LOMAS.

The "three-wire system" was to all intents and purposes simultaneously and independently invented by Edison in America and Dr. John Hopkinson in this country.

In America Edison companies were formed, and we thus have companies bearing this name in New York, Philadelphia, Chicago, and Boston, which, working on the most thorough lines, are gradually, in the different cities in which they exist, absorbing and converting to their own uses all rival companies, thus their systems are of enormous magnitude. For instance, the New York Edison Company has no fewer than five three-wire generating stations, as well as a battery sub-station, all linked together by feeders, so as to reinforce one another according to the load distribution. The service attached to the mains amounted at the end of 1896 to an equivalent of 540,312 16-candle-power lamps.

In England we have no three-wire stations that will compare from point of output, and the independent development of the system in two countries has led to many differences of detail, some of which are due to the immense disparity in size.

Considering the generating plant, first the type of engine or dynamo employed for any particular service is to a large extent influenced by the size required. The advantages of direct driving have long ago been recognised for electric lighting purposes, and this once settled, the requirements of engine and dynamo each tend to modify the other. The modern practice in the States tends to a vertical slow speed engine of the marine type.

In the great Duane Street station, the most modern development of the New York Edison Company, we find two crank quadruple expansion engines (two cylinders in tandem on each crank) of 2,500 H.P. So great is the space economy of this arrangement that power is generated at the rate of a H.P. for each half square foot of engine floor. In Chicago, three-crank triple-expansion engines of the same type are used, with one cylinder to each crank. In both cases the generators are carried on extensions of the shaft, without an outside bearing serving as fly-wheels in addition to their other duties. In England the high-speed engine has attained a popularity it has never reached on the other side of the water, the value of the Willans engine, both from point of view of its economy as a steam user and the small space it requires, is too well known to require more than mention.

As regards generators, the large output of the American demand a multipolar design, and though two-pole machines are almost invariably used here for small outputs, the advantages of the multipolar machine in larger sizes are fully recognised.

In the combined sets there is, however, this difference, that whereas in America each set forms in itself a three-wire unit, here it is quite as usual to have one or two balancing machines connected between the positive and neutral and neutral and negative respectively, and all the others connected across the "outers," that is to say, for the same output the Americans build two dynamos, each of half the output to our one of the whole output.

On the other hand they use their dynamos as flywheels and do not require an outside bearing, while we must have at least one three-wire unit or two complete sets giving the voltage between the outer and neutral wires. As regards switchboards and mains, in the most modern American practice all the mains within the station are fireproof, and at the switchboard itself copper of the highest conductivity is used throughout, even down to studs and nuts.

The now universally used Weston shunt ammeter is the natural outcome of the use of large currents, and the edgewise ammeter helps to make a very compact board. The practice of running at several potentials is, of course, incidental to the supply of a large area. The Edison tubing used for the mains consist of drawing in the three mains insulated with jute into iron pipes cast in lengths of 20 feet; a non-conducting compound is then forced in, effectually insulating the mains from each other and the pipe. This makes an exceedingly good piece of work, and breakdowns are rare, but repair is difficult.

The neutral is purposely grounded, the idea being that if a short circuit does occur, it will not have the full voltage of the "outers."

This grounding of the neutral is quite out of the question where bare copper mains are laid, as in some English practice, because after some working the resistance of the negative to earth becomes very low.

On the question of working costs the American, quite unusually we admit, is very reticent; direct comparison is, however, impossible, first because their rate of wages is so much higher, and secondly, they always include in their working costs the price of renewing, testing and trimming lamps both arc and incandescent.

The popularity of the "three-wire" system in the United Kingdom is rather marked, there being about 30 stations so equipped, and it is pleasing to be able to record that in the matter of electric lighting generally we can fairly hold our with the American.

The question of combined lighting and traction plants is very much before the English engineer now; as yet it has not been tried on a large scale and it is too early to get results from Dover, where an alternating lighting station supplies a part of the current for the trams by means of a motor generator, but this much may be said that a lighting plant on the three-wire system with 500 volts across the "outers" offers the most facilities and might, under special circumstances, be advantageously combined with a traction plant. At any rate in selecting a system this point is worth the consideration of any corporation proposing to install electric light, and it is the bounden duty of every corporation to equip their city with electric trams.

MARCONI TELEGRAPHY.

Experiments in Berlin and Vienna.

Continental Governments have not lagged far behind our own in testing the possibilities of the new telegraphy. The experiments by the Italian Government we have already described; the following description of the experiments that have been made in Germany are of equal, if not greater interest.

Prof. Slaby, of the technical high school, Charlottenburg, has carried out, at the instigation of the German Emperor, some very important experiments (on which we gave a report) to a number of representatives of the Government and others on the 2nd of this month.*

Dr. Slaby objects to the name "wireless telegraphy," which has been given to this system, and proposes instead to call it "spark telegraph." But it is just possible that some time in future it may be found that electric waves suitable for transmission of signals may be produced without the assistance of the electric spark, and in this case Dr. Slaby's name will be quite as inappropriate as "wireless telegraphy." If the name "wireless telegraphy" be taken in the sense that there is no line wire, there appears to be no great objection to it.

With the assistance of Dr. Dietz and Count Arco, Dr. Slaby has discovered a new application of what he calls "spark telegraphy." He found that telegraph wires lying in the path of the electric waves have the faculty of powerfully absorbing the electric waves. Messages can be sent through telegraph wires by these waves, which travel along the surface of the wires, without disturbing the transmission of waves by the ordinary currents. This discovery, therefore, points the way to a new system of duplex telegraphy.

Before Marconi's invention had been made known, Dr. Slaby and Dr. Dietz had made some experiments with "spark telegraphy," which, however, were not very successful, the maximum range attained being 50 metres. In the beginning of this year Dr. Slaby had the opportunity of personally inspecting the experiments which were being conducted with Marconi's apparatus in this country; and immediately after his return to Germany he started making experiments on his own account. From the beginning the Kaiser gave every encouragement and assistance in carrying out these experiments.

* See *Zeit für Elektrotechnik*, November 15th, 1897.

The royal gardens at Potsdam were placed at the disposal of Dr. Slaby, and naval and military balloon corps were detailed to assist him in his experiments. The first sending station was erected on an island in the Havel, and on shore at a distance of about two miles the receiving station was erected. The first experiments were unsuccessful. It was discovered that the fault lay in the coherer, which was too sensitive owing to the percentage of silver being too high. The hyper-sensitive coherer was affected by atmospheric electricity, and consequently the telegraphic messages were often blurred, or symbols were recorded by the receiving instrument when no message had been sent. Further experiments showed that the less sensitive the coherer the better the results obtained. At the present time, Dr. Slaby fills his coherer tube with grains of nickel, which, however, must be as rough and jagged in form as possible, and they must, of course, be carefully cleaned and dried.

The communication with the island having been found slow and tedious, the sending station was transferred to a church on shore, in whose portico the radiator was set up, while a wire to act as the so-called elevated conductor was supported by a mast erected on the church tower. The telegraphy here was wonderfully successful, having only failed on one occasion when a visit of inspection was expected from the Kaiser. The explanation of this failure was soon discovered; the radiator had been moved back a few yards further into the church to avoid a threatening shower, and as a result of this, part of the elevated wire had been bent parallel to the flagstone floor, for a distance of 2 metres, and at a distance of $1\frac{1}{2}$ metres from the floor. The radiation from this part of the wire was absorbed by the earth, and this shows how important it is that no horizontal wire near the earth's surface should be connected to the apparatus. When the radiator was restored to its original position, the apparatus worked again as well as ever.

The sending station was now taken back to the island, but the apparatus which had worked very well at the station on shore was found here to be subject to considerable disturbance. It was discovered that trees in the neighbourhood of the sending station absorbed the waves, and interfered with their transmission to the receiving station. The best transmission always took place when the wires of the receiving and the sending station were mutually visible from one another. Even the sail of a boat, or the smoke of a steamer coming between the two stations, was sufficient to perceptibly disturb the working of the receiving telegraph instrument.

It was, indeed, found possible to transmit signals through obstacles, and through buildings, but in these cases a considerable loss of energy had always to be reckoned on.

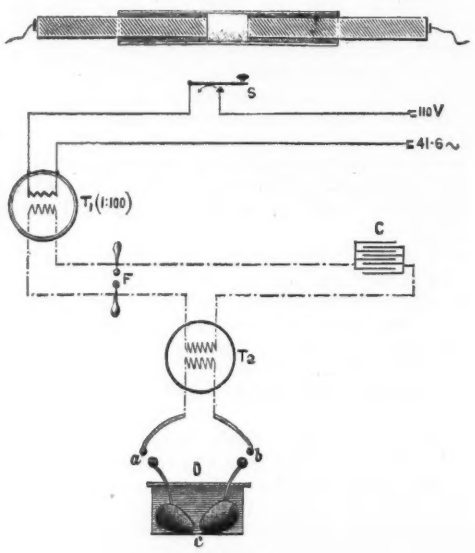
In order to make the wire on the island visible, it was lengthened from 25 metres to 65 metres, and placed in a boat on the Havel. The apparatus now worked pretty well, but not quite perfectly till the wire of the receiver was also lengthened to 65 metres. Experiment showed that the length of the wire was of essential importance; but the report goes on to assert, Dr. Slaby found that it did not matter whether the wire was horizontal or vertical. This statement must be erroneous, or else requires some qualification, for it contradicts the experience of Dr. Slaby recorded earlier in this paper, and also the experience of Captain Kennedy, in the experiments made in this country.*

Experiments were now tried over greater distances. Stations were erected at Schöneberg and Rangsdorf, 12·6 miles apart. Assistance was given by the military balloon department, and it was proposed at first that the cables of two captive balloons should be used as the elevated conductors. The action, however, was found to be much too strong, and the receiving apparatus never came to a standstill. A second experiment with a double telephone wire was more successful, though in this case also many signs were recorded by the receiving instrument that had never been telegraphed. Complete success was not obtained till a very thin copper wire of 0·4 mm. in diameter was used. The experiments had unfortunately to be broken off at this point, but it is intended to resume them at some future time.

Dr. Slaby, in conclusion, discussed the practical aspects of the new system of telegraphy. It had now been shown that the range of transmission was proportional to the length of the elevated conductor. In perfectly pure air such as is found out at sea, the range was 500 metres per metre of elevated conductor; on land, in impure air, the range was only 250 metres. For telegraphing between Calais and Dover (40 km.) a vertical wire of 80 metres (87 yards) would be required; and to establish communication with America a wire of 2,000 metres (1·2 miles) in length would suffice, if no allowance has to be made for the curvature of the earth. But if the electric waves are found to go in straight lines only, then they must in their passage from Europe to America pass through 191 km. (114·6 miles) of earth, and this would necessitate a considerable addition to the length of the elevated wires.

* Electrical Review, 41, p. 573.

Fig. 1.



T_2, Oil transformer.

Fig. 2.

The application to military field telegraphy appears to Dr. Slaby to be impracticable, since the enemy by keeping a powerful radiator continually in action could mix up your messages and render them unintelligible. For the marine, he considers that the invention will be of great value. By the use of captive balloons communication might be established between two fleets many miles apart. If the time

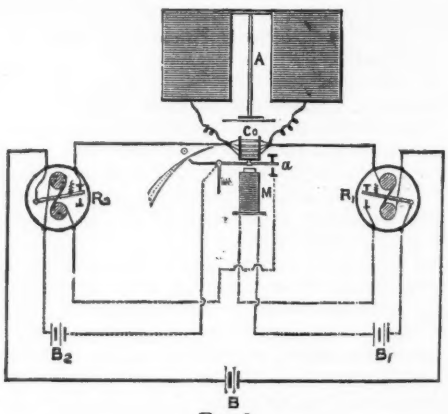


Fig. 3.

should come when every ship carried a receiver on board, warnings and other news could be transmitted from lighthouses to ships at sea.

At Vienna some experiments in Marconi telegraphy have been carried out by Dr. Tuma, which are especially interesting, on account of some modifications in the sending and receiving apparatus. As a spark producer, Dr. Tuma uses the well-known Tesla arrangement, instead of the induction coil. A coherer was used, having the space between the metal electrodes about one-quarter filled with nickel powder,

but not essentially differing from that used by Marconi (see fig. 1). The Tesla arrangement is shown in fig. 2. It is excited from an alternating street supply, having a voltage of 110, and a periodicity of 41·6. The voltage is transformed up in two steps to 150,000, and this is applied to the two oval electrodes of the radiator, which are immersed in petroleum contained in a glass trough. The main spark gap of the radiator, at *c*, is about 1 mm. in length, and there are two auxiliary spark gaps at *a* and *b*. The heat of the initial discharges at *c* produce bubbles of petroleum vapour, in which the subsequent discharges take place.

The receiving apparatus, fig. 3, comprises a colour writing telegraph instrument (by Leopolder & Son), on the armature of which is mounted a frame carrying a battery of four coherers, *c c*. To the terminals of the coherers are connected two tinfoil wings, supported on an insulating stand, A. To the terminals of the coherers, is also connected the circuit shown by a full line, containing the coherer battery, B, the magnets of the relay, R_1, which closes the circuit of the telegraph instrument, M, and its battery, B; and the armature lever of another relay, R_2, whose circuit is closed when the armature lever of the telegraph instrument, M, is pulled down. The relay, R_2, breaks the coherer circuit at the instant when the metal particles are shaken by the blow of the armature of M. Dr. Tuma has discovered that when the coherer circuit is previously broken, the vibration is more effective in bringing it back to its normal state.

INSULATION AND CABLE TESTING, WITH SUGGESTIONS FOR NEW APPARATUS.

In an interesting article on the above subject in a recent number of the *American Electrician*, Mr. N. Monroe Hopkins says:—

"The testing of insulation may be conveniently divided into two branches or systems; the break-down or puncture test and the actual measurement of electrical resistance in ohms.

"In the testing of porcelain and glass insulators designed for long-distance power transmission, certain classes of railway work and all lines for high electrical tension, the break-down test prevails, and in many instances is preferable to careful galvanometer measurements in the testing of insulation on wires and cables. The puncture test may again be divided into the dry and the wet test, the latter being far more severe for very obvious reasons.

"The difference of electrical potential brought to bear on insulators and cables varies, of course, with the thickness of the walls, in the case of porcelain insulators, and with the thickness and composition of the covering on wires and cables. In testing porcelain insulators a voltage of 40,000 for a period of 40 minutes would be a good test for insulators whose walls are at least 1 inch in thickness. For insulators with walls ½-inch thick, 30,000 volts for 40 minutes would be a good and severe test.

"When an insulator remains intact when subjected to a test of approximately this severity, it is usually pronounced perfect. This, however, should not be the case, for many insulators undergo this tension without cracking or breaking in any way, for the presence of a conducting mineral in the clay carries the current. These faulty insulators can at once be detected, as they become intensely heated in the neighbourhood of the conducting mineral. They are, however, in many cases, unjustly shipped with those that remain unaltered and cold, partially because they are not discovered, as they make no buzzing sound like the cracked ones, and partially because of the ignorance of the man in charge.

"Again, a test of this character is not a fair one if several heated insulators are allowed to remain on the testing table with the others, for the conducting minerals in the faulty ones only furnish electrical paths, or equalising paths, across the high voltage feed wires, with a result at once apparent.

"The high voltage for testing is obtained by an alternator designed for 1,000 volts. A 'step-down' transformer is introduced, lowering the voltage to 100, giving a convenient line current for the measuring instruments. A controlling or 'choking' coil is included next, whereby the voltage is slowly raised. An oil immersion transformer, or group of ordinary transformers designed to give the proper rise in voltage, is located in a safe and convenient place. The approximate voltage may be ascertained by taking readings from the instruments and estimating for the transformers, or by a table of spark gaps.

"For a 30,000-volt test, the spark gap should be set at 1½ inches on an average day.

"The testing table has an iron top, with poles to receive the insulators. A table wide enough for two or three rows is the usual practice, having a capacity for about 40 insulators at a time. It will be readily understood that the electrical stress is all between the end of the iron pin which rests in the insulator, and a circle described about the outside, where the circular pole supports it. This is a common type of testing table now in use.

"When tests are made, the generator is started and the switch over the transformer closed, with the controlling coil thrown well over for the maximum 'choking' effect. The instant the switch is thrown, a deep and loud humming noise is produced, changing in tone from a "singing" to a harsh buzzing, until an insulator cracks or punctures, when a shrill piercing sound is emitted, accompanied by the liberation of ozone, which is more or less noticeable from the time the switch is first thrown. The poorly baked and faulty insulators go to pieces within five minutes and those of a little better glaze, or more perfect baking do not follow much before 15 or 20 minutes. During the remaining 10 minutes of a test of about one-half hour very few, as a rule, puncture.

"Of course, when an insulator punctures its presence and location on the table is detected by its loud singing and the presence of a glow when it is in contact with the table top. The 'choking' coil is thrown over and the switch opened and the punctured insulator and its iron pin are removed. The fatality among carefully made insulators is from 8 to 10 per cent. when subjected to 30,000 volts, when their walls are not more than ½ inch thick. Of course, these figures will vary somewhat with different clays and bakings, &c."

For a wet test, Mr. Hopkins suggests that the insulators should be immersed (in the usual way) in *brine*, this we may say is totally unneccessary, as absolutely nothing is gained by using salt in preference to plain water.

It is very questionable whether the testing of a cable by passing it through a trough of water from one drum to another, as suggested by Mr. Hopkins, is at all a satisfactory one. This well known method is suitable for *localising a fault*, but for testing, the cable ought certainly to be wholly immersed under water in the usual manner. The use of brine in connection with such a test is also an absurdity.

AMERICAN v. BRITISH.

A Defence.

By F. B.

That of late a considerable quantity of American electrical machinery has been supplied to the order of British customers, is well known. That in some special branches the American manufacturer is in possession of greater experience, and therefore knowledge, than the British manufacturer, is admitted. But that American traction plant should find a market in Great Britain in competition with British production would appear to be the cause of much heart burning, and occasionally of not a little display of acerbity on the part of some who feel that their own work is being ousted. It is perhaps but natural that this feeling should be given expression to, for, after all, human nature finds it difficult to rise above the common lines, which are more or less selfish ones—rather more than less as a rule. British human nature is apt, too, to be of a somewhat pronounced and sturdy type. While the claim is made that love of the principle "Fair play and may the best win" is an innate national characteristic, yet it may be observed that there are some who reserve to themselves the privilege of "glorious inconsistency," as witness what occurs upon almost every occasion when the

American competitor scores over his British opponents in tendering for electrical traction and other contracts. A wail of indignation and resentment arises from the disappointed ones, which, were it but based on just and business-like grounds, would be worthy of a serious consideration. But what are the reasons behind this action? Does the British manufacturer decry the use of plant from across the Atlantic because it is of poorer and less efficient design than that made by himself, or because it has less skill and high class workmanship embodied in it than his own has? Well, no, not now; the days when such reflections could be uttered are past for the very excellent reason that every British order filled by American manufacturers has been a practical refutation of such bogus charges. American machinery has been, and is subject to the same tests prior to its acceptance; it has equally severe working conditions to contend with, and in addition is saddled with a far greater expense in transportation than is the case with British plant. In the face of this it competes, and that successfully, with all comers. Nor is it made by cheap labour; the American mechanic receives a high rate of wages, which is still high when compared with the cost of living. The British manufacturer who either cannot or will not be induced to study the *raison d'être* of these facts, and hating to see his own wares being supplanted, falls back upon sentiment for a battle cry. He appeals to the public to support "home industries," to give "employment to British labour," and so forth. But all the time he continues to offer an article that is becoming obsolete, or that is more or less crude, and if reproached on the former head, he, in effect, replies that it is as efficient as any that can be made, while in regard to the latter his answer is that he is not to blame because the public will only afford him limited opportunities for manufacturing this semi-developed apparatus. It is but just to say here that the British nation is about the most obstinately conservative one in all Christendom, so there is some show of reason for the fact that the electrical manufacturer of the country has not aided to any great extent in the perfecting of traction systems. It is very evident that since the people have resolutely objected to the introduction of up-to-date methods until quite recently, often bringing forward ridiculous reasons to sustain their attitude of hostility, the manufacturers could hardly be expected to acquire much experience in such work.

Now that the public opinion has been, with great effort (put forth almost entirely by American, not British firms), swayed to the other side, and electric traction made to boom, it is nothing more than just and equitable that those manufacturers who have so largely helped to develop the knowledge of the subject in other countries, should reap some of the fruits of their labours in this, which is commencing to avail itself of the pioneer work done elsewhere. But evidently some British manufacturers cannot see the fairness of this, because, doubtless, from their point of view, "the boot is on the wrong foot." When the steam engine was made a commercial success, British engineers offered no objection whatever to the filling of orders from foreign countries. And the same in the case of the locomotive. At the present day they are happy to send such plant abroad as they are paid for, even to countries that could themselves manufacture it. When it so happens, however, that certain branches of electrical work are, at great expenditure of money and energy, perfected outside of Great Britain, and when those who are responsible for this advance are given British orders to execute, there goes up a dog-in-the-manger cry, the motives of which are only too apparent.

The truth underlying the whole matter is not difficult to point out. Given a public notoriously conservative on the one hand, and, to a certain extent, bound up in vested interests on the other, it can be readily understood that the advantages offered by electrical science will not gain a very rapid headway. These characteristics will, nevertheless, operate to insure permanency in any progress that is made. Clearly then it would have been good business for the British manufacturer to have striven, in season and out, to win over the public to a thorough appreciation of the benefits awaiting acceptance, and in so doing he would have created the opportunities for enlarging his own experience. Instead of throwing himself, heart and soul, into a propaganda of this nature, he has been content to proceed along in a leisurely and very dignified manner, with the inevitable result that others elsewhere have seen their opportunity, and, being of hustling businesslike habits, have not been slow to grasp it.

Then again, although the British manufacturer has the advantages of low wages, cheap material, and very short distances of transportation, he either cannot or will not sell his goods on a level with his American rival. From this fact it is justifiable to infer one of two alternatives: either that an unduly large profit is looked for, or that the workshop management is of a low order.

To sum up the conclusions rendered apparent by the foregoing, it may be concisely stated that the manufacturer of American plant is entitled to the support he is receiving in Great Britain (not to mention the British Colonies) because he has very largely been the perfector of the highest and most satisfactory types of apparatus for traction and power purposes; because he has convinced the British public of the backward state of its urban and suburban transit facilities; because he has gained a knowledge and experience in the working of the most modern and satisfactory system of traction known, that few can equal, and finally, because he competes for this support under the condition which has for generations past been entwined into British business life: the purchase (other things being equal) in the cheapest market.

REGULATION OF FIELD CURRENT IN A THREE-PHASE GENERATOR WORKING SINGLY WITH A WIDELY VARYING MOTOR LOAD,

ALSO

THREE-PHASE MOTORS IN PRACTICE.

By ARTHUR H. GIBSON, A.I.E.E.

Such conditions as the above sometimes occur in practice and the arrangement does not work well. Assume such a generator to be working with a steady half load of motors, and the exciting current such as to maintain correct voltage. Now a motor of, say, one quarter of the total H.P. of generator is started, the immediate result is a momentary fall in volts and speed. The exciter is driven by same motive power as the generator, and thus revolves more slowly, with the result, that the exciting current, instead of being strengthened to raise the fallen pressure of circuit to normal, does not even remain at its former value but is diminished. This is a very undesirable state of things.

In the three-phase power plant installed at Liverpool by the General Electric Company, and described in these pages, the above has been provided against by means of a small motor with clutch gear, which operates the field regulating resistance, at the instigation of a relay voltmeter, placed in the L.T. station circuit. This gets over the difficulty, but is rather complicated, and if a simpler device can be constructed so much the better.

This question in the minimum resolves itself into whether an alternating current magnet can be constructed which will pull sufficiently with moderate consumption of energy for the following purpose.

Suppose a magnet similar in design to the well known device on Thomson-Houston arc lighting dynamos (but constructed for alternating current) to be fixed vertically, and an armature, slotted to avoid Foucault currents situated underneath, pivoted suitably, and a dashpot attached. The magnet is wound according to requirements and connected to generator L.T. side, and to the armature can be attached and balanced a sort of iron comb having teeth of varying lengths which are pointed. The comb is so fixed that the rocking movement engages always the first one and afterwards many or few of the remaining teeth with corresponding mercury cups below, according to the upward pull of magnet *versus* gravity or spring.

Mercury contacts have been ill fated in the past, and it seems antiquated to speak of such things in these days, but here there would be no sparking at these mercury cups, the resistance coils can be connected in parallel, and the circuit never broken; the level of mercury is not likely to give

trouble if overflow holes are provided. The resistance referred to may be either in the exciter shunt or exciting circuit.

The whole thing hangs upon the alternating current magnet. In looking for information on this point we see plenty of alternating arcs, most of which are actuated by a magnet. It looks quite likely that an experiment carefully conducted will result in a useful regulator for this particular purpose.

Re three-phase motors, I would like to ask the General Electric Company, in addition to the information already so generously sown broadcast, how the apparent watts on motor instruments compare with real watts which are absorbed in their Manchester-made motors.

In some Continental machinery the apparent watts vary very much in different motors of same make but different shape.

Some appear to take 10 to 15 times as many as the real watts absorbed.

Now no one objects to this, although it *is* a trifle difficult to "know where you are" when the wattmeter is disabled, but what we do object to is that such a motor sets up a lag which upsets the whole system, reduces the voltage, and causes well conducted, industrious motors much larger than itself to get uncomfortably warm over their work. There is, as yet, a whole field of three-phase work practically unexplored.

Three-phase systems, either for small or large areas, are, practically speaking, unknown in England, and, although a good deal has been said against it, the three-phase motor can take care of itself. The absence of commutators, brushes, and exposed live conductor in an installation of 30 or 40 motors of all sizes is a greater advantage than commonly supposed, however good commutators may be.

On the other hand the uniform speed so much belauded is rather a nuisance where small variations of speed are desired; the speed is practically unalterable, and any change of speed except by altering the whole system, must be made through gearing.

When the legal coast is clear for open competition we shall have these little eccentricities cleared up, and motors better and cheaper than any now manufactured.

Those inventors who have toiled for years on arc lamps and meters might, with advantage, turn their attention to the construction of a cheap, simple and strong instrument which can be attached direct to a motor and read direct in horse-powers the electrical energy absorbed.

And again, where in a three-phase motor the stator is the outside circuit, if a smooth iron cylinder, or say a cast-iron pulley, is substituted for the rotor, it will run up to speed and do work, but with loss of power.

Is it possible to construct this cylinder so as to do away, partly or entirely, with insulated windings?

THE INSTITUTION OF ELECTRICAL ENGINEERS.

The discussion on Mr. Epstein's paper on accumulator traction on rails and ordinary roads was resumed at a meeting of the Institution of Electrical Engineers on Thursday of last week. At the previous meeting the paper had been read, and Mr. E. Manby, Mr. Crompton, General Webber, Mr. Manville, Prof. Ayrton, Mr. Sam. Mavor, Prof. Perry, and Mr. E. T. Carter had spoken in the discussion, a summary of which appeared in our columns a fortnight ago.

The continuation of the discussion by the speakers at the meeting last Thursday brought out the varying opinions held on the subject of the proper value to allow for the tractive force of vehicles on common roads and the kind of batteries and treatment of cells best suited to the purpose.

The first speaker at the previous meeting (Mr. Manby) thought that it might be desirable to supplement his statement as to the accumulator used on the Dresden tramways, and added to information already given that the cells in question enabled the cars to run 130 miles with one charge. The battery employed consisted of 134 cells, weighing 5,300 lbs., and showed a figure of 77 lbs. per unit (kilowatt-hour), the efficiency being said to exceed 90 per cent. Mr. Epstein's idea of the method of dealing with cells in ordinary cases of traction was carried out inasmuch as the batteries did not require separate handling, being only charged in regular use once a day.

On the assumption that the life of cells depends upon the number of chargings, it might be taken that these would last seven months instead of 75 days, thus giving, as what might be expected in actual work, a life of 1,500 miles without renewal.

The complete weight of the car and its appurtenances, with paying load of passengers, was 12 tons, and a trailer in use weighed 5½ tons, or a total of 17½ tons. The total work done averaged 2,275 ton-miles per day, requiring something like 30 watt-hours per ton-mile, which was below the figure assumed by Mr. Epstein of 80 watt-hours per ton-mile, a quantity obviously dependent upon local and other conditions. Thus on a trial upon a special part of the road in Dresden, with gradients of 1 in 23, and possessing sharp curves, the actual energy worked out at less than 66 watt-hours per ton-mile hauled. The weight of the battery was 2,200 kilos. per car.

Prof. Ayrton remarked that the propulsion of vehicles on ordinary roads was an old love of Prof. Perry and himself. Our readers will remember that particulars of the Ayrton-Perry tricycle were given in the Electrical Review of November, 1882, and Prof. Ayrton referred to this as being one of the earliest attempts to utilise accumulators for traction purposes. The tricycle was actually run on the London streets, being fitted with some of the first E.P.S. cells ever made. The speaker agreed with Mr. Epstein that all early experiments were commercial failures, but it must be admitted they were very interesting. He considered that it would be desirable to add to the account of the Hanover combined trolley and accumulator system, some particulars of the proportion of length of line the car received current from the trolley wire, and from the accumulators alone; also, that something might be added regarding the probable cost, as it was not quite clear from the paper what it was. Prof. Ayrton had to congratulate Mr. Epstein on his contribution to a subject of vital importance to electrical engineers; when he was asked some eight months ago to advise on the question he had advised against the likelihood of the use of accumulators being successful. No one would be more delighted than himself to find that this was not the actual result, and he longed for Mr. Manville to prove him to be in error in this opinion.

He knew that Mr. Epstein was only too anxious that others should know the truth about his own accumulators, and when he was asked to test these batteries no suggestion of a rosy report was made—far from it—for he was told to test the cells by treating them as badly as he could, so as to learn the good points by submitting them to the roughest possible treatment; there was to be no application of the varnish brush to his statements.

Statements regarding accumulator traction depended on (*a*) storage capacity of cells and (*b*) the resistance to traction. Taking (*a*) first, a great many experiments had been made in Prof. Ayrton's laboratory, charging night and day incessantly, so as to get the true cyclic conditions, and he therefore might have some knowledge of what might be expected.

In the report on a certain accumulator recently issued to the public, there was no statement as to whether a cycle of charges and discharges had been carried out, or how long a period the tests had covered. It was claimed that these particular cells would give 14 watt-hours per pound of gross weight, which if true, meant that these cells gave twice what Prof. Ayrton had been able to obtain with any other accumulator. Certainly the numbers generally got were nothing nearly as large. The circular issued by the makers of the cell did not claim half what was vouched for as having been obtained; it is possible that some makers only claimed half of what they knew their cells could give. On the other hand there were the results reached by the accumulators in Belgium, giving 13 watt-hours per pound, or 77 lbs. per unit gross weight. The best results Prof. Ayrton had even obtained were more like half the figure mentioned, that was 8 watt-hours per pound. So much the better *if* the higher figures were obtainable.

Coming to (*b*) tractive force, which Mr. Crompton put

down as much below 50 lbs. per ton, Prof. Ayrton had not been able to experiment with electric cabs, but had found that for a bicycle on a concreted road the figure was 30 lbs. per ton, with the gearing in good condition, and at a speed of 5½ miles per hour. The figure rose to 43 lbs. per ton for a bicycle on a macadamised road at 12½ miles per hour, while experiment on a very good macadamised road slightly wet showed 62 lbs. per ton at 10-12 miles per hour against the wind and 40 lbs. with the wind. Taking into account gearing and greater friction at an axle Prof. Ayrton did not think Mr. Epstein's estimate at all excessive, but if anything rather below the probable figure and a trifle small. In January of 1896 Mr. Ravenshaw gave some figures as to tractive force found in experiments on bicycles, the lowest being 30 lbs. per ton at four to eight miles per hour, going up to 146 lbs. in heavy mud. From this it would be seen that large figures were to be expected.

Mr. Epstein gave a 52 passenger car as having 2¼ tons of accumulators; for the best Prof. Ayrton had ever tested the weight would require to be double—say 8 tons of car loaded, and would require at least 4 H.P. to propel the vehicle at eight miles per hour. Taking another case stated, a small car for three or four people, 2 effective horse-power at the driving axle is stated as sufficient for eight miles per hour on the level. The London Electric Cab with three passengers requires 3 H.P. from batteries on smooth road and 5 H.P. on macadam road. Taking 60 lbs. resistance, calculation agree with the figure Mr. Manville has given. Experiments showed that double the figures quoted above are frequently absolutely necessary.

The question was asked why it was necessary to go to America for the motors for London cabs, although it was true that the Lundell motor of American origin was far lighter than anything made in this country.

Mr. Thomas Parker remarked that it took a great deal of time to learn anything reliable about accumulators. The Birmingham tramway system, so far as its original accumulator arrangements went, were designed by him, and it is probably the best thing one has to refer to. He was asked to design a locomotive to compete with the steam tramway engines, and did so; the locomotive, weighing 8 tons with fixed accumulators charged when stationary, proved satisfactory, but when the extensions came forward the contractors were not left a free hand; inasmuch as it was specified that identical cars with those on the cable tramways should be used, and that a speed of 15 miles per hour should be capable of attainment.

The trouble with cells is that they lose their capacity, which cannot be recovered, when subjected to abnormal discharges. Mr. Parker considered that notwithstanding, given a free hand, a good electrical and mechanical job could be made of accumulator vehicles, and that they could be run at a profit. He also gave some details of an accumulator vehicle for ordinary roads being constructed by his son.

Mr. E. Wilson went at length into the data derived from some tests he had made of Faure-King cells, and explained the bearing of his results upon the figures in the paper. These figures and the trend of the remarks, bristling as they do with statistics of what he found, may be usefully studied when the *Journal* of the Institution comes out, but do not readily lend themselves to a summary of the leading points in the discussion.

Mr. Cuthbert Hall mentioned that the size of cells tested plates affects results owing to the proportion of dead or useless "negative." He considered charging at constant potential gives more efficient results than charging at constant current. Also drew attention to the fact that volume of active material must not be confused with surface, owing to slight penetration of chemical change into the mass of the plate.

Mr. R. Raworth pointed out that the cells used for lighting on the trains of the Brighton and South Coast Railway are subjected to most violent shaking, but are not deteriorated.

Mr. J. W. Swan concurred with those speakers who advocated the charging of cells at constant pressure. He briefly referred to the competition between pasted and formed plates, and expressed his opinion that the only safe course was the complete renewal of plates when they gave trouble, rather than any attempt to patch them up.

Mr. E. T. Carter reiterated his question regarding series and parallel coupling of batteries, and stated that he found the Headland electric carriage was controlled in this way.

Mr. Holroyd Smith spoke very plainly on the subject of makers' and vendors' claims for batteries, and quoted instances where well nigh impossible figures had been put forward. He also warned engineers of the mistake of adopting too low a figure for tractive force. Mr. Brown dealt with the question of tractive force also, and emphasised the importance of providing ample power on the motor vehicles. Owing to the lengthy discussion, the consideration of Mr. Epstein's paper stands adjourned for discussion at a special meeting before Christmas.

ELECTRIC DISTRIBUTION IN NAVY YARDS.

A letter signed by Prof. Dodge, evidently connected with the Training Department of the U.S. Navy, is published in the Annual Report of the Secretary of the Navy. It is, in brief, a series of statement of the advantages of electrical distribution of power in the Navy yards from one central point (in each yard).

At the present time the various Departments are conducted on individualistic lines as regards power, and possess each one, or even more, boiler plants, each with its fireman or men. Bring the total demand for steam to one point, and the total boiler power would be greatly less, as also the number of men. But the concentration of boilers would be impossible, because of long steam pipes.

Each shop has its own engine, generally of uneconomical type, often old, and, perhaps, too old to warrant special attention. Concentrate the engine power close to the boilers, and at once an immense saving of steam is attained by the use of larger better-attended engines, with only at most say two engineers in place of a dozen or two. But in a large yard the difficulty would be to convey power to distant shops, and concentration of either boilers or engines is not so simple after all.

Even when the power is produced it is chiefly swallowed up in turning long lines of useless shafting in each of many shops, no matter whether many or few men are at work. With electric motors only such machines or short lengths of shafting actually required need to be run, and all large machines should have their own motor, the smaller machines being grouped to motors from 7½ to 10 H.P.

If power is distributed from a central point by belts or shafting there is always a huge standing loss of power, but with electricity the line loss in even an extensive yard would not be serious, and by the suggested concentration of power at one centre and the use of electrical transmission a whole yard can be economically served with power, and the waste is kept low, and simply varies with the work being done in place of being as large for periods of little work as it is for periods of heavy work, for as each machine is cut off the waste incidental to that machine is also cut off. This is an important matter in a navy yard, where the amount of work is liable to vary very considerably.

The economy to be effected by electricity is thus several fold. First the power delivered to the shops is utilised more completely in what may be termed net work, the gross work is reduced, in fact, and a high efficiency factor secured.

Secondly, the engine power will be of a more economical type, and will be attended by a minimum of men under better conditions.

Thirdly, the steam for such engines will be generated under more economical and efficient conditions.

Fifthly, the number of employés will be reduced all round. Further, the electric form of energy is capable of more elastic application in many ways, and this has been proved by both the tramways and by such private shops as have adopted electrical driving. Not content with the general statement, of which we have abstracted the drift the professor particularises in regard to the stations at Port Royal and Port Orchard, where an electric plant could be worked by the same men who now attend to the rolls and to certain pumps, while a storage battery would furnish light for the shops and quarters.

The same holds true also of League Island, where power and light would be furnished for less than the present cost

of power alone. In regard to the yard at Norfolk, the author's investigation leads him to the conclusion that at least half the present cost, or $12,000 annually, could be saved by electric transmission, &c. Tests at the Washington yard showed that the shafting alone absorbed as much power as would, applied electrically, drive all the machinery.

We need not follow the author into his hypothetical cases and figures which correctly show him that no engineer would instal a separate steam plant to drive several groups of machinery in one large shop. He would naturally put down one steam plant equal to the driving of the lot, and this would obviously be of smaller power than the sum of the several plants. Yet in a Navy yard the one large shop is scattered, and cannot be worked economically from one power centre, nor can the power be economically sub-divided. Electricity alone, of all modes of transmission, steps in to offer a cheap and easy solution of the problem.

It makes practically no difference to electricity whether its operations are conducted in a closely-collected area or widely spread. The position of a building has no known effect upon the efficiency of a motor, nor does it present the difficulties in the way of leading in an electric conductor as does a want of squareness present with a shaft or a rope transmission. Electrical transmission, in short, secures almost all its advantages in the fact that its shafting, to use a mechanical simile, runs almost without friction, and neither requires to be turned true nor to be kept in line. Consequently we may use as much of it as we require and it is cheaper to use long lengths of it than to scatter steam engines and boilers over the area to be served. The Professor's report ought to be convincing to the authorities even though they be the usual stamp of officialdom.

CORRESPONDENCE.

Distribution of Electrical Energy.

As one who has been deeply interested in Mr. Wordingham's paper on the distribution of electrical energy, and having read the extraordinary remarks made by Mr. Rankin Kennedy in the Review, permit me, as "an unfortunate alternate current engineer," whose station will very soon become obsolete, to at least die fighting.

I cannot possibly conceive how Mr. Rankin Kennedy can draw such bigoted conclusions, as certainly by his own logic one could reason that the high tension system was progressing, whereas his pet baby would soon be relegated to the dust heap. Having followed the battle of the systems on the "field of the I.E.E." with great interest, and being possessed of prejudice neither way—in fact, if anything, a preference for the L.T. system. Mr. Rankin Kennedy is a long way behind the times in actual practice; take, for instance, his remarks:—"Ten years is long enough to conclusively prove the superiority of the one or the other." According to this logic, adding up the number of municipal works in 1897 on the H.T. system, the numbers are, respectively, 27 H.T. and 19 L.T. Six towns on the high-tension system were started last year, whereas there was only *one* town on the L.T. system. Does this look like the H.T. system becoming obsolete?!!

Had he desired to prophecy, and been well acquainted with what is going on in central station practice, both in this kingdom and abroad, especially where extensions are going on rapidly, and L.T. engineers are looking around them to find some conceivable dodge for raising the pressure, without being told they are going in for H.T., he would have prophecied, as is my firm belief, that the future supply of electricity on a large scale will be carried out by three-phase generators at the works, delivering energy at H.P. to dynamotors; *i.e.*, a three-phase H.T. motor, driving on the same shaft an ordinary direct current dynamo, situated in suitable sub-stations in different districts of the town. The three-wire system, with 500 volts across the outers, or in smaller towns, two-wire system with 250 volts between the outers for supply to consumers. This system has another great advantage; when the grandmotherly legislation of the B.O.T. is sufficiently "curbed" and shaken, that it will be possible where large motors for factory use (say 100 H.P.), instead of being run off the L.T. mains, causing serious irregularities of the pressure, and an annoyance to the light consumer, will derive their energy from the H.P. feeders, running *large three-phase motors at H.P.*, instead of a direct current motor, with its "sparking commutator difficulties." Mr. Rankin Kennedy casts a slur on consulting engineers' characters, which is unjustified, and requires an apology, especially should his article reach the hands of Town Councillors using the H.T. system. Direct current distribution has many advantages over alternate current; but it will, within a very few years, in towns where a "decent" percentage of the inhabitants consume electricity for many purposes, be impossible to supply them on the L.T. system; they will, as is now being largely done, revert to probably the H.T. direct current system, which is unfortunately far more complicated than the three-phase (as enumerated above) would be.

As one of the engineers who visited Manchester at the Municipal Convention, I could not help feeling surprised at the ingenuity Mr. Wordingham had exercised to get over the difficulties of low tension supply, such as having equalisers, motor generators, and many other things buried under the ground, and I was somewhat surprised that he should think so much of that system of supply.

Evidently he ought to experience the simplicity and the beauty of the H.P. supply delivering into the low pressure network.

Mr. Rankin Kennedy asserts that the only advantage of the H.T. system is the saving in copper, and he goes on to make an entirely erroneous statement, which cannot be substantiated. There is one simple fact, out of the 27 towns that have adopted the H.T. system, not one of these towns have altered their works to L.T., whereas of the 19 towns supplying on the L.T. system, most of them are now seriously considering the advisability for going in for the H.T. current supply, with the necessary H.T. feeders, sub-stations, &c., Mr. Rankin Kennedy condemns. With regard to the saving in the cost of copper, he apparently is unacquainted with the capital outlay that would be involved, provided some of the H.T. towns (the one I am responsible for, especially) were to have adopted the L.T. system. The whole of the capital expended would have gone in a "seam" of copper along the streets. It is all very well for the L.T. engineers to point to H.T. costs, &c., and say they are beating the H.T. hollow; probably they are, and likely to; but place these low tension engineers with their L.T. system in the towns that have adopted the H.T. system, and then see where they would be; they could neither make their works pay, nor supply the commodity to give satisfaction. However, comparisons like these are odious, and only uttered by the ignorant. Before a consulting engineer can give an opinion as to which system is the best, there are very many local circumstances to consider, such as the demand per 100 yards cable laid, which Mr. Rankin Kennedy is apparently ignorant of. Whilst on the question of advantage of one system over the other, does he not consider it an advantage, from a consumer's point of view, that *the* voltage required for an arc lamp can be given without wasting energy in useless resistances? *That* the life of incandescent lamps are slightly longer? *That* there is less danger from alternating current at 250 volts when a fuse blows than with direct (has been proved by actual tests, and not by theory)? *That* it is possible to maintain a much more *even* pressure, giving consumers greater satisfaction, as well as what they are paying for? *That* no balancing transformer or apparatus are necessary? *That* it is commercially possible to light large and scattered areas? *That* there is great facility for extensions as the demand increases? *That* the generators are more simple and less costly, having no commutators? *That* the generators are more solid and mechanically constructed? I notice the Deptford system is mentioned in his criticisms. He must remember that it was started a great many years ago, and that with our present knowledge, the Deptford system, would be (provided that all London could be obtained to-day) one of the most gigantic commercial successes possible; but unfortunately for the promoters, the knowledge in those days was not so perfect as it is now. He then states, "The original alternating system does not exist." I do not know if he considers this a *disadvantage;* to my mind it simply shows that we

have made important advance, certainly this is no argument for condemning it. He then states, "we find two distinct systems connected through sub-stations," but the complications will be far greater later on in direct current supply. He states that these alternate current mains require to be special and costly. Why? There is no reason from an engineering point of view to prevent L.T. alternate current distribution by bare copper mains, provided due precautions were taken to prevent losses outside the actual resistance, only it not being necessary to bury a copper mine, we have a perfectly insulated cable, where burn-outs are almost unknown. Perhaps the most amusing paragraph to alternate current engineers and municipal engineers responsible for electricity works, is Mr. Rankin Kennedy's sympathy and sorrow "for the number of small towns committed to a system which will be superseded entirely." I cannot but think Mr. Rankin Kennedy must for the last five or six years have been asleep as to what has been done with alternate current distribution, and I can assure him that his sympathy is wasted entirely, as the percentage of towns which have got the H.T. where L.T. would have been suitable, is *extremely* small. He again expresses his ignorance when he states "that instead of improving, it is always becoming more and more complicated." Is Mr. Rankin Kennedy familar with the switchboard that was installed at the City of London works? and the new one which is erected by Ferranti's? Is he familiar with the alternate current generators that were built five years ago, and the ones that are built in 1897? Is he familiar with the good high tension cables which were impossible a few years ago? Is he familiar with the fact that we are now reducing the number of transformers to a minimum? Whereas a high tension feeder would be formerly tapped for every consumer, it is now tapped but once, and that, to supply the large transformer from which the L.P. supply is given. Is he familiar with the new alternate current meters? Certainly his remarks do not convey that idea; as alternate current distribution has certainly simplified itself wonderfully during the last few years.

Personally, having had experience in both low and high tension working, manufacturing as well as supply, I have not found the great advantages possessed by one over the other, as mentioned by Mr. Rankin Kennedy. The main point where the H.T. system scores is in the better *regulation* of pressure, and consequently the longer life of the lamps. At a low tension station, it is necessary to have somebody to alter the pressure regulators constantly, whereas in a H.T. station this is not the case.

The above remarks are only written to defend the system much abused by Mr. Rankin Kennedy.

H. L. P. Boot,
Borough Electrical Engineer.

Tunbridge Wells.

The Langdon-Davies Motor.

The circular of the Inventor's Patent Office having come under my notice, I shall be glad if you will allow me to draw attention to one or two misleading statements.

In the first place it is inferred that the Inventor's Patent Office (Mr. Eaton) was concerned in developing the Langdon-Davies alternate current motor, which was acquired by the Davies Motor Company in August, 1896. This is not the case. The workshop illustrated in the circular was, at the time when the early experimenting work on the Langdon-Davies motor was being carried out, in the occupation of Mr. de Tunzelmann, and I am informed is so still.

Secondly, so far from the motor having been at that time developed into a commercial machine, comparatively little development work had been done, and the Davies Motor Company has only recently considered the motor sufficiently developed to place it on the market.

A. Soames,
Managing Director of the Davies Motor Company, Limited.

Shoreditch Destructor and Electrical Works.

Your correspondent "Power," in last week's REVIEW, gives some 60 tons of refuse as the amount burnt in the development of 250 kw. I think he will find upon inquiry that 100 tons is the real quantity. St. Giles is sending half of its refuse to Shoreditch, so that you have a population of 124,000 (Shoreditch) plus 22,000 (St. Giles)—or a total population of 146,000 supplying house refuse, to give a maximum load of 250 kw. Surely this is an object lesson (of how not to do it) worth studying.

X. Y. Z.

December 1st, 1897.

ADMINISTRATION REPORT OF THE INDIAN TELEGRAPH DEPARTMENT, 1896-97.

In the very full and interesting report issued by the Indian Telegraph Department, there are many points which will be of interest to our readers. Not the least noticeable of these is the steady increase in the mileage of Indian telegraph lines, which, taken together with the fact that the speed of transmission has been well maintained, in face of the exceptional difficulties which have been met with in India during the last year, reflects much credit on all concerned. During the year in question hurricanes, floods, and earthquake, besides the pressure of traffic occasioned by the risings on the frontier, have seriously hampered the work of the department, which, however, has managed to maintain the efficiency of the service. We are glad to notice the tribute paid by the Director-General of Telegraphs to the superintendent and staff of the Bombay office, for the manner in which their duties were carried on during the trying time of the plague.

The period of five years is taken for purposes of comparison; the statistics of the present year being compared with those of the year 1892-93. We find that during this time the mileage of wire, which now stands at 148,136, has increased by 21,885 miles. The telegraph offices now number 4,252, of which 828 are new; some of these, however, are not maintained by the Department. The figures for the two years show that the number of paid telegrams now stands at 5 077,584, being 1,096,173 more than in 1892-93, and that the excess of revenue of one year over the other is Rs. 1,265,614, while the increase of capital account amounts to Rs. 6,161,374. The annual value of messages at present standing at Rs. 7,033,563, and the capital expenditure standing at Rs. 60,507,989.

We find that the "foreign" messages (under which heading are also included messages in "transit" across India, and having origin and destination outside of India), have increased from 539,774, the total in 1892-93, to 690,756 for the current year, an increase of about 28 per cent. It is very significant that this growth of traffic is principally due to the augmentation of "transit" traffic, which has steadily grown, while foreign traffic to and from India has remained almost stationary. The number of messages in "transit" across India has risen from 220,735 to 339,499, or, say, 54 per cent. This important point has not failed to attract the attention of the Department, and has been referred to in previous reports. This growth of "transit" traffic is almost entirely to be attributed to the reductions in rates made from time to time by the Eastern Extension, China and Australasian Telegraph Company, who were further assisted in this direction by a diminution made by the Indian Government in the amount charged on "transit" telegrams. This reduction in Indian transit rates came into force on July 1st, 1892, with the result that in the succeeding year the Indian Government sustained a loss on this account alone of Rs. 152,500, which loss, however, in the following year, fell to Rs. 21,872, and in the year 1894-95 showed a "credit" balance of Rs. 98,250, as compared with the year before the transit rates were reduced. From this it is clear that the Indian Government has borne its share in the attempts to modernise traffic rates, and has made some sacrifice in doing so. Under these circumstances it is disappointing to find that the efforts of Messrs. Luke & Finch, the Indian delegates to the Buda Pest Conference, did not meet with a better reception. These gentlemen were, according to the report, "instructed, both by the Government of India, and the Secretary of State for India, in the interests of Indian commerce, to urge upon the representatives of the Eastern and Indo-European Telegraph Companies the desirability of a reduction in the rate for telegrams between India and Europe. Notwithstanding, however, their strongest representations, and the warm support of the British delegates, the opposition of the companies, both to a general reduction and to the alternative proposal of a reduction on messages in plain language, proved insurmountable. The companies, while most anxious to meet the wishes of the Government of India, regretted that they could not, for financial reasons, agree to risk the loss that any reduction would involve, in consequence of the stationary character of the Indian telegraph traffic." The reason given by the companies is of the weakest, in face of their own experience and the experience of the Indian Government, that previous reductions in rates had speedily been followed by an increasing amount of traffic, and we think that the Indian Government have undoubted cause for complaint. In return for the reduction in transit rate and the consequent temporary loss; in return for the transmission of transit messages on an equal footing with "urgent" messages (which in India cost double the amount of "ordinary" telegrams), the department is told that owing to the "stationary" character of its traffic it cannot obtain any reduction. The "stationary" character being simply due to the refusal on the part of the Eastern, Indo-European, and Eastern-Extension Telegraph Companies to treat the Indian public as regards rates in the same way as they have with such satisfactory results dealt with Australia and the far East.

It is not too much to say that the sacrifices made by India, not only as concerns the advantages given to "transit" messages, but also in continuing to pay an excessive rate for foreign telegrams, are only so many benefits bestowed on Australia and the other Eastern localities, in favour of which cable-rates have lately been lowered by the companies. It would be absurd, were it not financially serious, that a telegram can be sent from London to Australia across India for 4s. 9d. per word, while a similar telegram from London to Australia, if re-transmitted at Bombay, cost 9s. 1½d. To put it in another way—a merchant in Bombay has to pay 4s. per word to London and 5s. 1½d. per word to Australia, while a merchant in Adelaide only pays 4s. 9d. per word for a telegram going direct to London through Bombay. The Indian Government is further threatened by the companies with a loss on any advantage it may at present derive from its "transit" receipts by the laying of a system of cables to Australia from which India will be excluded. As it appears that argument is useless, some advantage might be gained were the Department to arrange to relegate "transit" messages to the same level as "ordinary" or "deferred" inland telegrams, and thus be able for the benefit of the Indian public to widen the scope of the "urgent" telegrams at a diminished working cost.

THE LANGDON-DAVIES MOTOR.

In our issue for June 26th, 1896, we described the Langdon-Davies self-starting monophase induction motor at considerable length, giving various illustrations such as sectional views of the motor, curves of brake horse-power and speed, brake horse-power and efficiency, &c. The Davies Motor Company, Limited, of Red Lion Street, E.C., has supplied these motors to consumers on the circuits of the following electric lighting undertakings:—

City of London, Wandsworth, Clerkenwell (St. Luke's), Bedford, Halifax, Hanley, Huddersfield, Derby, Newcastle, Portsmouth, Leeds, Salford, Bournemouth, House-to-House Company (London).

We are informed that wherever they are being used they are working thoroughly satisfactorily.

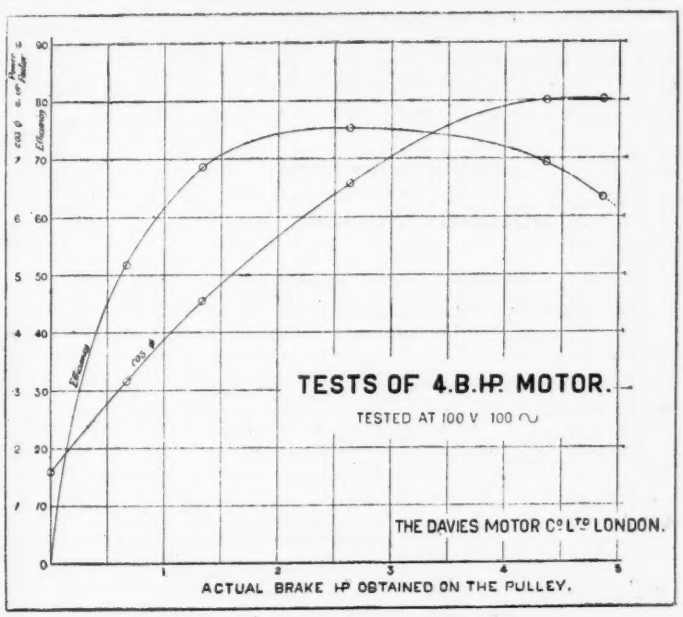
In regard to cost, it is stated that on circuits where the charge is 2d. per unit, the cost of power in a 3 H.P. size is 2d. per H.P. per hour. It must be borne in mind, however, that there being no commutator or brushes, the repairs are an absolute minimum, the only wearing parts being the two bearings. It is claimed that the motors are very compact and light, advantages which are easily appreciated. Where silent running is essential, such as in offices for working ventilating fans, for running hairdressers' brushes, &c., the motors are found to be very suitable.

The motors are wound so that the full load current is not exceeded at starting, thus avoiding one of the many objections to previous alternate current motors.

The starting is effected by a two-way switch and resistance, there being no condenser to get out of order. A double pulley is provided, so that the motor may be started up with an idle belt on the countershaft, and thrown over on to a fast pulley when running at full speed.

We give herewith an efficiency curve of one of these 4-H.P. motors, which is typical of the other sizes.

The company is also letting these motors out on hire. The motors are all tested on Soames's new patent absorption brake, for efficiency and power factor, before leaving the works.



LEGAL.

Taylor v. Sax.

In this action an electrical engineer, reported at considerable length in this journal on the 19th of November, Mr. A. G. McIntyre, counsel for the plaintiff, on Monday last, asked Lord Justices Smith, Rigby, and Collins, sitting in the Court of Appeal, for leave to serve notice of motion on the defendant for a new trial on appeal from the finding for the defendant by Mr. Justice Channell, who heard the case in the second week of the present month.

Plaintiff sued as the assignee of one, Gomer, of a commission note, dated January, 1896, promising him £500 in shares in the event of his getting a transfer of the Lambeth Electric Lighting Order of 1892 to a new company, and floating the same successfully. A company to purchase the order was formed in 1896, the Board of Trade having refused to recognise any private individual in the matter, and it was alleged that Gomer assisted to this end; but it was the case for the defendant that he received nothing from the venture and had no interest in the company. Leave was asked to appeal from the learned judge's finding for the defendant, chiefly on the ground that he had not in the disclosure of documents revealed in particular an agreement which it was said had an important and direct bearing on the defence and was in contradiction of it as showing that in respect of bonus to him by his father-in-law, one Vandenberg, he had assigned to him his rights against the company, and the company, out of a total of £6,000, had paid to Vandenberg £1,700 for the purpose of settling claims against the defendant for services in respect to the formation of the company. Plaintiff's counsel said he did not suggest that this was wilfully concealed from, but it was not revealed to him, important as was its bearing on the action.

For the respondent, defendant to the action, Mr. Tindal Atkinson, Q.C., opposed the application on two grounds: (1) That three days after the trial plaintiff knew the facts on which the present proceeding was based, and yet had allowed the statutory eight days to pass; and (2) that although it was true the correspondence in the matter between the Vestry and the defendant was not disclosed, his client's application to the Board of Trade for the transfer of the order was disclosed, and should have put plaintiff on an enquiry, besides proving his knowledge of some correspondence before the trial.

As the result of about an hour-and-a-half's arguments, the above being merely an outline of the facts, their Lordships granted the application.

Howell v. The Cymmer Glyncorrwg Coal Company, Limited, and Others, and W. R. Randall and R. K. Pritchard.

This action came on for hearing before Mr. Justice Grantham and a special jury at the Glamorgan Assizes on Tuesday. The plaintiff, Mr. John Charles Howell, carried on business as a contractor and electrical engineer in London and Llanelly, and the defendants were two colliery companies. The plaintiff made allegations of fraud and misrepresentation against the defendants, in respect of an agreement to supply the colliery company with electric pumping plant into which the plaintiff had been induced to enter, in consequence of such misrepresentation and fraud. Plaintiff further claimed damages against the defendants, Randall and Pritchard, and asked for an order to set aside a certain agreement.

Mr. S. T. Evans, M.P., who appeared on behalf of the plaintiff, stated that Mr. Pritchard was a gentleman residing in the neighbourhood of Bridgend, and Mr. Randall was a solicitor of that town. His case was that the two defendants had been parties to acts and arrangements, the effect of which was that they deliberately misrepresented the facts in order to obtain from the plaintiff a large quantity of valuable electrical machinery, and that having obtained it, they deliberately set themselves to work to defeat his claim for payment. In 1891, the defendant Randall and some other gentlemen were the freeholders of some seams of coal near Bridgend, and the company was formed to work them. Apparently the company did not prosper, and the defendants, Randall, Pritchard and others, early in 1894 consulted an eminent engineer, who advised them to obtain electric pumping plant in order to overcome the water which their existing pumping plant was unable to cope with. On September 17th, 1894, a contract was entered into under which a company, of which plaintiff was a director and a large shareholder, named J. C. Howell, Limited, agreed to supply the necessary plant for £1,650, and subsequently, with extras, the amount was increased to £2,173. The plaintiff's company was unable to obtain payment so commenced an action against the company, but that action was compromised by the payment of £70 in cash and four bills of £500 each, but only one of these bills had been paid. In May, 1896, Mr. Howell was told that there were debentures on the property, and that he would never be paid a single farthing if he continued to press the company, the debenture holders would appoint a receiver. Until then the plaintiff had never been informed of the creation of these debentures. In October 1894, the old company was wound up, and another company of the same name was formed, and debentures were created to the extent of £30,000 as a first charge on the whole property, and of those debentures £20,500 went to Mr. Randall, and £2,000 to Mr. Pritchard. When Mr. Howell's pressure

became too strong, he was told that all the property of the company, "including your plant," was covered by the debentures. Eventually a receiver was appointed on behalf of the debenture holders in the person of Mr. Pritchard's son, and the whole of the colliery, which was valued at £36,000, was sold for £11,000. The plaintiff alleged that these debentures were created in November, 1894, for the purpose of defeating his claim for the machinery supplied. He further alleged that the debentures were created a short time only, after he had taken the contract for the work. That, at the same time, the old company was wound up, and another company of the same name formed, therefore, that the directors had fradulently concealed the winding up of the old company, which would have given plaintiff the right to refuse to supply the plant. The plaintiff asked for damages against Mr. Randall and Mr. Pritchard for this fraudulent act on their part, and he also asked the jury to say that the agreement, by which the debentures were issued, should be set aside as being fraudulent and void, as against the creditors of the company.

Mr. Abel Thomas, Q.C., M.P., for the defendants, submitted that there was no case to go before a jury. He suggested that the plaintiff knew all about the reconstruction of the company, and, even if he did not, he could have easily ascertained by searching the files at Somerset House, as he subsequently did. The reason the company was wound up and reconstructed was for the purpose of issuing the the debentures and consolidating the various interests of the old company. If the company had been successful, every one would have been paid, but unfortunately it was not a success. He confidently asked the jury to say that no case of fraud had been made out, as the allegations of plaintiff amounted to a criminal charge.

Eventually the case was adjourned.

The Syndicate of Electrical Engineers, Limited *v.* Lawrence and Butcher.

In the Westminster County Court on Wednesday, the above case was tried by his Honour Judge Lumley Smith, Q.C., and was a claim against Messrs. Lawrence & Butcher, of Sutton Street, Piccadilly, for the hire of a testing machine.

His Honour gave judgment for the plaintiffs for £3 with costs.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week Ending Nov. 30th, 1896.	£	s.	Week Ending Nov. 30th, 1897.	£	s.
Adelaide	19	0	Adelaide	12	0
Albany	60	0	Amsterdam	77	0
Alexandria. Teleg. mat.	292	0	Antwerp. Elec. fuses...	47	0
Amsterdam	40	0	Buenos Ayres	50	0
Antwerp	130	0	Bangkok	480	0
Bombay	150	0	Calcutta	397	0
Buenos Ayres. Teleg. mat.	162	0	Canton	30	0
Calcutta	715	0	Cape Town	381	0
Cape Town	1,099	0	Colombo	40	0
Christchurch	18	0	Constantinople ...	16	0
Colombo	7	0	Copenhagen	60	0
Durban	18	0	Durban	118	0
„ Telephones ...	150	0	„ (40 tons miscellaneous stores)		
East London	2,575	0	Hamburg	296	0
Hamburg. Teleg. mat.	112	0	Hong Kong	150	0
Hong Kong	132	0	Liban	8	0
Madras	45	0	Lisbon	596	0
Melbourne	21	0	Madras	37	0
„ Teleg. mat ...	175	0	Malta	76	0
Oporto. Teleg. mat. ...	19	0	Melbourne	129	0
Port Elizabeth	20	0	Montreal	36	0
Revas	150	0	Odessa. Teleg. mat. ...	23	0
St. Petersburg	70	0	Ostend	40	0
Santos. Teleg. mat. ...	75	0	Port Said	65	0
Shanghai	230	0	(Shanghai—44 tons old telegraph wire)		
Singapore	10	0	Singapore	74	0
„ Teleg. mat....	100	0	Sydney	1,290	0
Sydney	283	0	„ Teleg. mat. ...	2,117	0
Trieste. Teleg. mat. ...	16	0	Syra	170	0
Wellington	27	0	Yokohama. Teleg. cable	1,109	0
Yokohama	460	0			
Total	£7,380	0	Total	£7,924	0

Foreign Goods Transhipped.

	£	s.		£	s.
Stockholm. Teleg. mat.	10	0	Melbourne	42	0

An Explanation.—With reference to the recent case, "Stanley *v.* The Magnolia Anti-Friction Metal Company of Great Britain," heard at the Manchester Assizes before Mr. Justice Bruce and a special jury, and which was decided on November 13th in the plaintiff's favour, Mr. Ernest F. Stanley, of the Magnolia Anti-Friction Metal Company of Great Britain, Limited, of 32, Victoria Street, S.W., writes, pointing out to "prevent a natural misconstruction, that the defendant company was a partnership, composed of John Sugden, John Latham Pound, and Max Wagner, which has been dissolved as long since as July, 1896." "The action," says Mr. Stanley, "was not against the Magnolia Anti-Friction Metal Company of Great Britain, *Limited*, with whom I am now connected, and *who only* are empowered to supply the original and only genuine Magnolia metal. As the similarity in the firms' titles might do the latter company an injury, will you kindly mark the distinction by publishing this letter."

Cable Making in Scotland.—It is understood that the Craigpark Works at Alexandra Parade, Glasgow, for the manufacture of electric light and other cables, will commence operation in a week or two. The capital of the company, £30,000, has been privately subscribed.

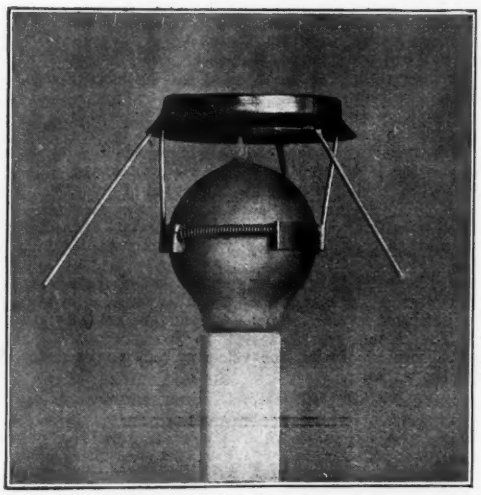
"Calvert's Mechanics' Almanack."—We have before us a copy of "Calvert's Mechanics' Almanack and Workshop Companion" for 1898, a handy 4d. pamphlet, which is compiled and edited by Mr. Joseph Nasmith, M.I.M.E., editor of the *Textile Recorder*. The publication has now reached the 25th year of its appearance. In addition to the usual almanack matter, it contains a good deal of practical, technical and industrial data for mechanical, engineering and various trades.

Carbon Manufacture.—We are informed that Mr. C. Conradty, of Nuremberg, has bought the carbon business of Ch. Schmelzer, of the same town, as and from November 1st last.

Catalogues.—Messrs. James Guthrie & Co., of Leather Lane, send us a copy of their 1897-8 season stove catalogue, also lists of gas and electric light fittings.

From Messrs. Callender & Montgomery, of 43, Essex Street, Strand, who are the sole selling agents for Callender's Cable and Construction Company, Limited, we have received an illustrated list in which is given some interesting information anent Callender's bitumen sheeting, the source of the material from which it is obtained, the various purposes for which it is used. The illustrations are for the most part photos. of bridges, waterworks, churches, and public and other buildings where it is employed. There are some views of the asphaltum lakes at Trinidad.

D. G. Improved Shade Carrier.—We give herewith a drawing of a patent shade carrier for supporting electric candle shades which Messrs. Drake & Gorham are now putting on the market. It has been designed to remedy the two defects in the ordinary butterfly carrier, namely, the scratching of the imitation candle by the spring clip and the liability of the shades to remain in crooked attitudes. The D. G. "invisible" carrier consists of a spun brass ring at the top on which the shade rests, and to this ring



is fixed by means of two wires a thin brass band made of very springy metal which clips on to the incandescent lamp itself. The band does not entirely surround the lamp, but the circle is completed by a spiral spring which besides fastening the carrier securely to the lamp allows for variation in the diameter of the bulb. The second object of the carrier is attained by fixing three brass wires to the top supporting ring, which wires can be bent to any angle corresponding with that of the candle shade. By this means it is claimed that the shades will always be kept straight.

Electrical Affairs in Austria.—The *Financial News*, in a recent Vienna despatch, stated that the Austrian Electric Company is about to make a fresh issue of shares, which will have the effect of increasing its capital from 6,000,000 fl. to 8,000,000 fl. The shareholders are to be offered the new scrip at 132½ per cent. The increase has been brought about not only in consequence of the steady growth of the business, but also because of the transformation of the Vienna Tramway Company into an electric company. The Anglo-Bank conducts the business of the company. Mr. Siemens, of Siemens & Halske, who are the largest shareholders in the electric company, was recently in Vienna, and took the opportunity to confer with Dr. Lueger, the Burgomaster.

Elmores.—*Money* says:—"Our old friends the Elmore Copper Company want to be in the fashion. Amalgamation has, therefore, been mooted, and, indeed, the scheme has gone some way towards completion. It will include four companies—Elmore's Patent Copper, Elmore's Wire, Elmore's American, and Elmore's Foreign and Colonial. We believe that the idea is to give each holder of shares in the four companies an equal number of shares in the new issue. Working capital is to be provided for the new company by a debenture issue at a low rate of interest, and the whole of the present liabilities will be discharged in full. There will be no public issue, the necessary funds being otherwise provided. It is necessary perhaps to add the customary caution that Mr. Hooley is believed to have nothing to do with the deal."

Exhibition.—At the Smithfield Show, London, which will be open from December 6th to 10th, 1897, Messrs. E. Humphries and Co., Limited, of Pershore, will exhibit a 6-H.P. portable steam engine, a 4 feet 6 inches thrashing machine, and a 7-B.H.P. stationary Atlas oil engine. This plant was also shown at the Birmingham Cattle Show just closed.

Halifax.—Messrs. E. Foster & Sons, Limited, have secured the contract for putting in the electric light fittings in connection with the improvements and extensions of King's Cross Constitutional Club.

Light Locomotives.—Messrs. H. K. Porter & Co., of Pittsburgh, Pa., have sent us a copy of the eighth edition of their catalogue of light locomotives. Messrs. Porter are manufacturers of such locomotives for steam, compressed air, and electric power. In addition to the usual business information, there is a large quantity of general data useful in the construction and equipment of lines. There are tables of tractive force, sizes of driving wheels, hauling capacity, particulars *re* gradients, the measurement, laying out, and resistance of curves, and the elevation of outer rails on same; speed, gauge of track, and details of rails and estimates of cost of track. Underground haulage in mines (electricity, steam, and compressed air), and compressed air motor cars, are briefly mentioned, and there is a number of good photographs showing locomotives working on each of the three systems.

Liquidation Notices.—A meeting of the Akester Electric Syndicate will be held at 71 and 72, King William Street, on Friday, December 31st, to hear an account of the winding-up operations from Mr. J. D. Pattullo, the liquidator.

The *London Gazette* notifies the appointment of Mr. P. W. Northey, of Ashley Cottage, Ewell, Surrey, as liquidator of the Epstein Electric Accumulator Company.

A meeting of the Electrical Manufacturers, Limited, will be held on Friday, December 31st, at 11 o'clock, at 13, Basinghall Street, E.C., to hear an account of the winding-up from the liquidator (Mr. G. A. G. Robertson), and to contract business usual at such meetings.

Parliamentary Bills.—The *Times* of Tuesday, last week, contained particulars of two Bills which are to be applied for during the forthcoming session.

The Eastern Telegraph Company, Limited, announce that they intend to apply for a Bill for the conversion and consolidation of their preference shares into preference stock, "and, if necessary or desirable, to provide that the holders of such preference stock shall be entitled to receive a cumulative preferential dividend of £3 10s. per cent. per annum, or some other rate per cent. per annum to be prescribed by the Bill, out of the net receipts or profits of the company from time to time." Provision will be made in the Bill for the creation and issue by the company—and the vesting in and acceptance by the holders of the existing preference shares to be converted and consolidated—of preference stock in substitution therefor, "upon such terms and conditions as may be considered necessary or desirable." For these purposes the company will ask for authority to increase the nominal amount of their existing preference share capital, and for the general purposes of the company or of the Bill, to apply their funds and revenues, and to raise further monies by the creation and issue of new shares or stock, with or without a preferential or guaranteed dividend, or other rights or privileges, and by borrowing, and by the creation and issue of debenture stock; "and to define and prescribe the ranking of any such shares, stock, or debenture stock." Powers will be sought for to enable or require trustees and other persons under disability to accept the converted or consolidated preference stock in substitution for the existing preference shares held by them, and also to enable them and other persons to consent to the Bill.

The Metropolitan Electric Supply Company, Limited, notify their intention of applying for a Bill to authorise them to hold and use as a station for generating electric current or electrical energy certain lands recently acquired by them at Willesden and Acton, and to establish and work on these lands plant for generating electrical energy, and for other purposes incidental to or connected with their undertaking or business. Power will be asked to enable the company to lay down an electric cable or wire, or lines of cable or wire, together with any necessary conduits, pipes, tubes or coverings, inspection boxes, and other conveniences and appliances from the lands mentioned to the company's station at Amberley Road, Paddington. It is intended to seek power to lay such cable or wire, or lines of cable or wire, along Acton Lane, Minet Avenue, Harley Road, Bramshill Road, Station Road, Tubbs Road, High Street, Harlesden, Harrow Road, and Amberley Road. Similar powers will be asked for enabling the company to lay a cable, with the necessary conveniences, along the Grand Junction Canal, or its towing path, commencing at the company's works on the lands referred to in Willesden and Acton, passing thence through Willesden, Acton, Hammersmith, St. Mary Abbot, Kensington, and Chelsea, to and terminating in Paddington at the company's works at Amberley Road.

The Troubles of an Electric Cab.—Last week a motor cab driver, of Clapham, was fined 10s. and 2s. costs at the South-West London Police Court, on Thursday last, for driving a motor cab without a light on the night of November 12th. Police constable 400 W stated that the defendant was in charge of a motor cab, and attached to it was another motor cab, which he said had met with an accident. When the cab stopped, the electric light flashed into the lamps; but as soon as he started going again, the lamps went out. He admitted that the cab was going at a very slow pace. For the defence, it was contended that defendant went down to Kingston to fetch a cab that had broken down, and the road was so bad, that the electricity in his cab became exhausted.

Trusty Oil Engines.—The Trusty Engine Works, of Cheltenham, have issued a new and improved catalogue of the "Trusty" oil engines, containing several illustrations of newly designed engines, and other improvements. Description, specification, plan of working, report of trials made by Mr. Worby Beaumont and Mr. H. Kilgour, are among the contents. We understand that these engines secured the highest award and gold medal at the Queensland International Exhibition held at Brisbane this year.

Watertight Bells.—We are informed that Mr. H. M. Salmony has been appointed sole agent for the watertight bell made by Messrs. Dixon, Clayton & Co., and described in our last issue.

W. H. Wilcox & Co., Limited.—The business carried on by W. H. Wilcox & Co., engineers' stores, oil refiners, &c., has been converted into a limited liability company, for family reasons. The management will be as formerly. Additional offices have been taken at 23, Southwark Street, S.E. No shares have been offered to the general public, but the employés have the opportunity of subscribing.

ELECTRIC LIGHTING NOTES.

Aberdeen.—The £10,000 loan for electric lighting has been sanctioned, making the total amount expended upon the undertaking £52,000. It is proposed to instal another 600 H.P. engine in view of rapid extensions. The electrical engineer is to report on this point.

Acton.—The District Council, last week, discussed the electric lighting question. It was reported that a poll showed two-thirds of the ratepayers to be in favour of the light. Information is to be obtained as to the number of lamps that would be taken up, and estimates prepared as to the probable cost, &c.

Barking.—At last week's Council meeting, the Lighting Committee recommended, and it was resolved, that the following tenders be provisionally accepted:—Section A. (plant), Sunderland Forge Company, £2,250. Section C. (switchboard), Laing, Wharton and Down, £478. Sections E. and F. (mains), Callender's Cable and Construction Company, £4,549. The engineer is to report upon the tender of the Reason Manufacturing Company at £930.

Blackpool.—At the annual meeting of the Blackpool Winter Gardens Company, held on Saturday, attention was drawn to the electric installation—which was said to be the largest private installation in the kingdom—that had been put down at a cost of £20,642, and to the fact that new extensions during the year had cost £45,857.

Blockley.—The residents have been going into the question of oil *v.* electricity for lighting, and a committee has decided in favour of electricity, provided the necessary funds could be got. Mr. H. N. Warburton offered to light the streets with 28 lamps, all costs included, for £35 per annum.

Bradford.—The Board of Guardians has decided to fit up the Nurses' Home with 121 electric lamps, at a cost of £186. The contract has been given to Messrs. H. Scholes & Co., of Manchester.

A meeting of the Manchester and District Institution of Gas Engineers was held here on Saturday. They inspected the new electricity works, and in the afternoon Mr. A. H. Gibbings, electrical engineer to the Bradford Corporation, described the new works.

Camberwell.—The General Purposes Committee of the Vestry reported at Wednesday's meeting that they had received a letter from the Board of Trade in regard to the London Electric Supply Corporation's provisional order relating to part of Camberwell. The Board stated that the Board did not appear to have any power to revoke the order as to part of the area of supply without the consent of the undertakers, or to prevent the undertakers exercising their powers under the order while it still remained in force. The Committee further stated that Mr. Stewart Bain, the Receiver and Manager of the London Electric Supply Corporation, attended the Committee and offered to supply electric light to any municipal buildings in the line of route if required by the Vestry at a sum not exceeding 5d. per unit, and to light the roadways at a sum not exceeding 3d. per unit, and to undertake to complete the work in not more than six months from date of order by the Vestry. The Committee accordingly recommended that subject to terms to the above effect being properly placed before the Vestry, an agreement should be entered into between the parties. Mr. Bain, in confirming the above offer by letter, suggested that "should your

Vestry decide to apply for an order for the other and larger part of the parish, in which only one order has been granted, such application would probably be successful, and should your Vestry decide to make such application, I would be quite prepared to supply the Vestry with current, at wholesale terms, which they could distribute through their own mains, and thus avoid the large capital outlay in building a station and laying down plant, &c. Any arrangement of this nature would not preclude the Vestry, if they so desired at any future time, from building their own station."

Coventry.—Mr. Ram, the manager of the electricity works, recently reported on the electric lighting of St. Mary's Hall and the adjoining rooms. A sub-committee has been appointed by the Council to go into the matter with him.

Devonport.—The Royal Hotel is to be lighted electrically, and Messrs. Lord & Shand, of Plymouth, have obtained the order.

Dudley.—The Star Inn, Eve Hill, is being lighted by electricity. Messrs. Webster, Michelson & Co. put in the plant. This firm has also supplied a complete installation for Messrs. Thomas Turner & Co's. bicycle factory at Wolverhampton, including a Dudley C-type dynamo.

Dundee.—Extensions are to be made to the electric street lighting, about 30 lamps being added for various thoroughfares. The lamps will be of 2 000 C.P. each, and it is anticipated that the work will be completed by the end of January.

Dublin.—The United Tramways Company have laid an important proposal before the Corporation, in which they submit the following points for consideration:—1. That the Corporation should transfer their lighting order to the company. 2. That the Corporation should assign the company all the buildings, plant, stores, &c., used in the lighting of the city. 3. The company will accept the transfer with all its rights and privileges, and will take over the obligation for the balance of the debt incurred by the Corporation for the lighting installation, and will undertake to pay the annual instalments of interest and sinking fund, or to pay off the debts at the company's option. 4. The company will undertake to provide necessary cables and plant with all possible speed to supply the existing demands for private or public lighting. 5. The company will undertake to reduce the price from the present price of 7d. per Board of Trade unit to 6d. and 4d. respectively for private and public lighting six months after the transfer of the order, and when their new power station is in working order, or, say, within two years, to further reduce the price to 5d. and 3d. respectively. 6. The company is further prepared to largely extend the lighting area beyond the compulsory area mentioned in the order. 7. The company would take over any of the staff or employés in the Corporation lighting station who desire to enter the company's employment. This company was formed for the acquisition of the Dublin United Tramways Company and the Dublin Southern District Tramways Company, both of which have powers for electric traction. The United Company is considering the desirability of erecting a great central generating station for the purpose of supplying electric current to both these companies' lines, but the lighting proposals mentioned above will only be possible in connection with an electric light station with very large engines and dynamos, which will be running at least 16 hours out of the 24. The company offers to meet a committee and discuss details, and to afford every possible assistance to expedite the transfer, so that they may replace the damaged cables with the least possible delay. It will be remembered that the proposed loan of £20.000 to be raised by the Corporation for repairing the defective cables has not been sanctioned by the Local Government Board.

The contract for the electric lighting of the Dublin Cycle, Tyre, and Motor Car Exhibition, to be held in January, has been secured by Messrs. Tuck & Co., Limited. The installation will comprise engines, dynamos, 30 arc lamps, and 1,000 incandescents. The same firm is putting down an installation at the Banagher Distillery where there will be an engine and dynamo and 300 lamps (incandescents and arcs); and at the Drogheda Steam Laundry they are also putting in engines, dynamos, and boilers for arc and incandescent lighting.

Edinburgh.—We understand that the Lighting Committee of the Town Council has agreed to order new machines and boilers to fill up the whole of the present stations, also to recommend that new offices be put up at Dewar Place. It was reported to the committee that the number of lights applied for since October 22nd to the middle of November was 4,136 8-candle-power lamps. It was agreed to take ground for the new power station from the Heriot Trust at M'Donald Road, Leith Walk, extending to about two to three acres. The station will be for continuous current machines.

Electric Lighting of Catacombs.—The catacombs of Calixtus, outside the Porta San Sebastiano, Rome, were last week illuminated by electric light.

Garston.—The Board of Trade has revoked the Allerton, Woolton, Childwall, and Garston Electric Lighting Order, 1896, as confirmed by the Electric Lighting Orders Confirmation (No. 7) Act, 1896, in so far as the Order relates to the district of Garston.

Glasgow.—The Watching and Lighting Committee have discussed a proposal to light the Springburn electric tramway route by electricity. The estimated cost is £1,800 as compared with £400 for gas. It has been resolved not to entertain the proposal

Greenock.—A deputation of local manufacturers and business men waited on the Finance Committee of the Police Board the other day to press the claims of electricity. Mr. Sharp, advising engineer to the N.B. Electricity Company, Limited, formed one of the party.

Hammersmith.—The Vestry has decided to supply current for motive power purposes at 2½d. per unit for a minimum of 48 hours per week.

Hampstead.—The Vestry is wanting an assistant electrical engineer. Particulars as to qualifications, salary, &c., will be found among our "Official Notices."

Hastings.—It will be remembered that the late Town Council resolved upon the purchase of the Hastings Electric Light Company's undertaking for a stated sum. There was, however, a feeling in certain quarters that the sum arranged was too high. A new Council is now in power, and at its first meeting held last week, several members protested against the pursuance of the purchase contract with the company any further. The voting, however, left the matter in its original position.

Hull.—The Electric Lighting Committee have decided to increase the salary of the electrical engineer by £100 per annum, and that of the assistant engineer by £46 per year.

Huyton.—The District Council will not apply for a provisional order, but the British Insulated Wire Company, who are making application, offered that body to supply electricity to the district at 6d. per unit, and to supply, free of charge, the wiring of the public lamps. A further offer by the company reduces the cost to 4d. per unit. In the company's order is a clause providing for the purchase of the undertaking within 14 years.

London County Council.—Among the batch of electric lighting notices submitted by the Highways Committee at Tuesday's meeting of the London County Council was one from the County of London and Brush Provincial Electric Lighting Company, of intention to lay high and low tension mains in Rosebery Avenue, Laystall Street, Clerkenwell Road, Charles Street, St. John's Street, Charterhouse Street and Carthusian Street; power and low tension mains in Saffron Hill, Hatton Garden, Gray's Inn Road, Cow Cross Street and Benjamin Street; high and low tension mains in St. John's Square, Farringdon Road, Cross Street, St. John's Lane and Leather Lane; and low tension mains in Back Hill, Fox Court, Kirby Street, Baldwin Gardens, Ely Place and Charterhouse Square; and also to construct four transformer boxes. The Committee saw no objection to the laying of the proposed mains, and thought the works might be approved. With regard to the construction of the transformer boxes, however, the Committee were still of the opinion which they had previously expressed, that such large portions of the public streets should not be appropriated for the purposes of a private undertaking; and with a view to the matter being again considered by the Board of Trade, they thought that the Council should withhold its sanction, against which decision the company would no doubt appeal, to the construction of the four transformer boxes referred to. The Committee made recommendations accordingly.

Newhaven.—The Rottingdean Electric Lighting and Power Company's application for a provisional order is to be opposed by the Newhaven Council.

Poplar.—The County of London and Brush Company has notified the District Board of its intention to apply for a provisional order, and for the cancellation of the Board's order already obtained. Mr. F. F. Bennett wrote asking for the appointment of consulting electrical engineer to the Board.

Redditch.—An electric lighting scheme prepared by Mr. McMullen for lighting the central portions of the town was for 1,800 lights, the cost being estimated at £8,000, but as residents have already promised to take up 2,500 lamps, he is to prepare a larger scheme.

Southampton.—The County Council last week considered a report from the Electric Lighting Committee, recommending the acceptance of the tender of Messrs. Crompton & Co., Ltd., for Section A. (£7,033) and B. (£5,653), of the new machinery required at the new electric station, with an alteration reducing the tender by £200, and also the acceptance of the tender of the Chloride Electrical Storage Syndicate, Limited, Manchester, for Section C. (£1,314), also the same firm's tender for maintenance at £73 per annum for seven years. The committee also reported that an application had been received from the lessees of the Royal York Music Hall for a supply equal to about 1,000 8-candle-power lamps by December 20th, and that a guarantee had been given for the required supply. The committee's report was adopted.

Some extensive municipal common lodging houses which are to be built at a cost of £14,500, are to be electrically lighted.

St. Helens.—The Local Government Board has sanctioned the borrowing of £16 500 in respect to the proposed extension of the electric lighting. The mains are to be extended in several streets.

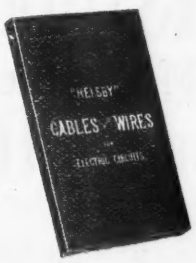
Stourbridge.—The District Council is purchasing a site for destructor plant, and it is expected that that body will put its electric lighting powers into force shortly and work the two things together.

St. Pancras.—The Vestry has resolved to light by means of electric arc lamps the Prince of Wales Road, Malden Road, Queen's Crescent, and Ferdinand Street (from Chalk Farm to Mother Shipton), and to provide private lighting mains in these localities, at a total estimated cost of £5,422.

OF VALUE and INTEREST to EVERY ENGINEER,
The most complete CATALOGUE yet issued; 91 pages.

"HELSBY" CABLES AND WIRES.

For
Lighting,
Power,
Telephony,
Tramways,
Telegraphy,
Signals, &c.



For Any Voltage and Any Situation.

Single,
Concentric,
Three-Phase,
Cables, &c.

The TELEGRAPH MFG., Co., Ltd., HELSBY, near Warrington.
11, Queen Victoria St., LONDON. 2, Parsonage, MANCHESTER. 30, Hope St., GLASGOW. 6, Victoria St., BELFAST. 1134

Telegraphic Addresses:
"VERITY, BIRMINGHAM."
"VERITY, LONDON."

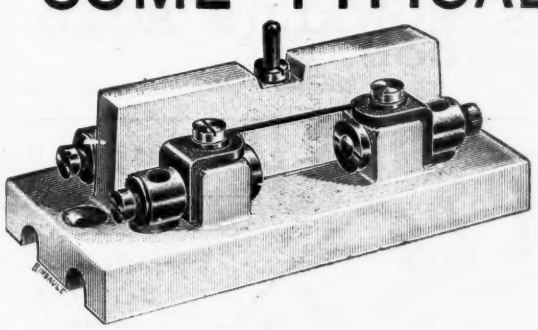
VERITYS, LTD.,

TRADE MARK

ELECTRICAL FITTINGS AND ACCESSORIES MANUFACTURERS,

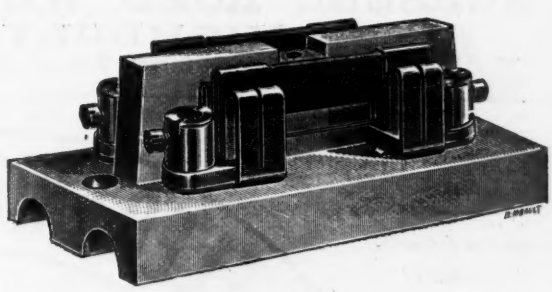
PLUME WORKS, ASTON, BIRMINGHAM.
KING STREET, COVENT GARDEN, LONDON.
PRINCESS STREET, MANCHESTER.

SOME TYPICAL D.P. CUT-OUTS.



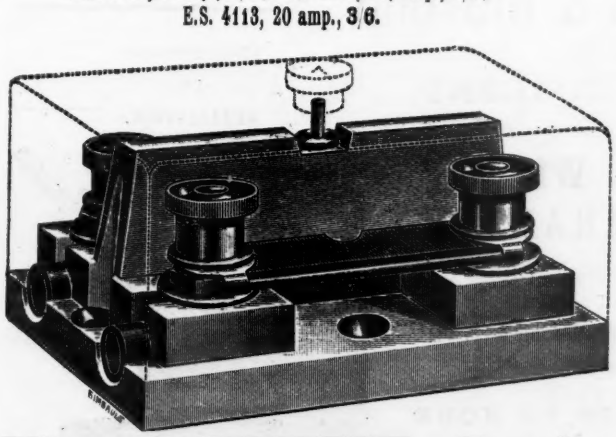
The Screw-down Type, Single and Double Pole.

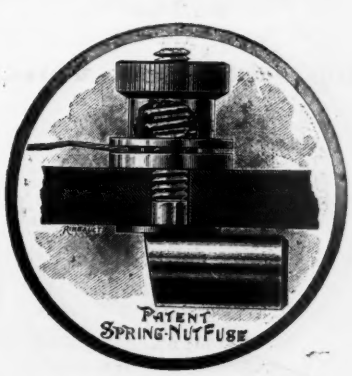
E.S. 4111, 5 amp., 1/9; E.S. 4112, 10, amp., 2/6; E.S. 4113, 20 amp., 3/6.



The Spring Clip Type D.P.

E.S. 3932, 10 amp., 2/6; E.S. 3933, 20 amp., 3/6; E.S. 3944, 30 amp., 5/-; E.S. 3934½, 50 amp., 7/-.





The PATENT Spring-Nut Type. D.P.

E.S. 4013, 30 amp., 5/-; E.S. 4014, 50 amp., 7/-; E.S. 4015, 100 amp., 12/-

VERITYS, MAKERS OF { All kinds of Electrical Accessories. High-Class Electric Light Fittings.

6225—6

DAVY

ELECTRICAL CONSTRUCTION CO., LTD.

Electrical and Mechanical Engineers.

"DAVY ENCLOSED ARC LAMPS,"

ALTERNATING AND CONTINUOUS.

The ONLY Enclosed Alternating Arc Lamp that is a success.

As used by Islington Vestry (London), Corporation of Leeds, Great Northern Railway Co. (London), Société l'Energie Electrique, Havre, Belfast Harbour Board, &c.

Any frequency. 6 amp. to 9 amp. SIMPLE and DURABLE.

The Davy Enclosed Alternating and Continuous Arc Lamp having proved a great success, this Company is determined to maintain the lead, and are shortly bringing out a New Type of Lamp that will eclipse anything previously produced.

A GREAT SUCCESS.

PATENT HOISTING GEAR,

SPECIALLY ADAPTED FOR STREET LIGHTING.

This Company manufacture their own Patents, and do not infringe the Patent Rights of any other Firm.

This Company will pay a reward of £10 in cash to any person or firm giving satisfactory proof that such person or firm has been threatened with action for infringement by selling the Patent Enclosed Arc Lamp as manufactured by the Davy Electrical Construction Co.

HORSELL ROAD WORKS, RONALD'S ROAD, HIGHBURY, LONDON, N.

West End Office—15, Victoria Street, Westminster, S.W. Telegrams:—"ARCAZON, LONDON." 1255

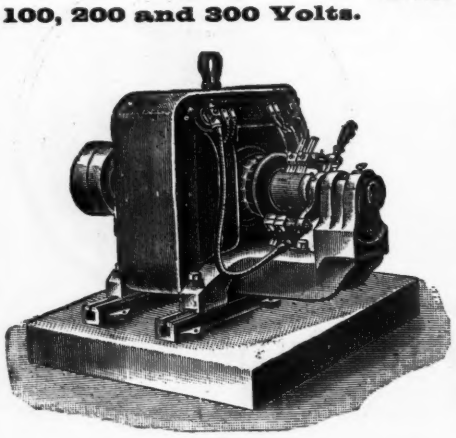
Telegraphic Address — "GALVANOSCOPE," LONDON.

THE ELECTRICAL CO., LTD.

Telephone:— No. 35,028, GERRARD.

DYNAMOS & MOTORS

SUITABLE FOR 100, 200 and 300 Volts. FOR DIRECT CURRENT. TESTIMONIALS ON APPLICATION.



WE GUARANTEE

THESE MACHINES TO BE OF BEST WORKMANSHIP & FINISH.

Absolutely Sparkless AND SECOND TO NONE ON THE MARKET.

LIBERAL DISCOUNT.

ONLY ADDRESS:

122-124, CHARING CROSS ROAD, LONDON, W.C.

ALL THE

STREET ARC LAMPS

Recently Erected in

HAMMERSMITH

and SHOREDITCH

are

"BROCKIE-PELLS"

Manufactured under our Patents by the late Licensees.

Trade Mark:—"BROCHIPEL." Telegrams:—"ILLUMINERS, LONDON."

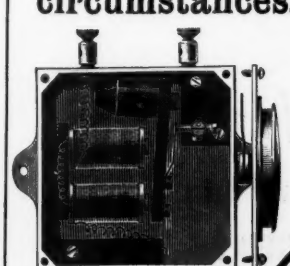
BROCKIE-PELL ARC LAMP, LTD.,

97, Queen Victoria St., LONDON, E.C. 724

DIXON, CLAYTON & CO.,

PENISTONE.

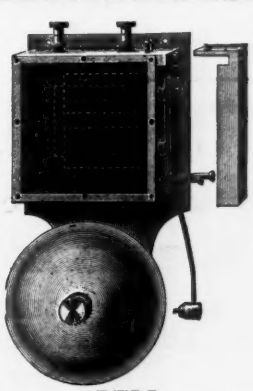
Colliery or Railway Bell, absolutely WATER-TIGHT, and reliable under all circumstances.



KEY.

WATER-TIGHT ELECTRIC BELLS.

CABINET WORK for ELECTRICIANS.

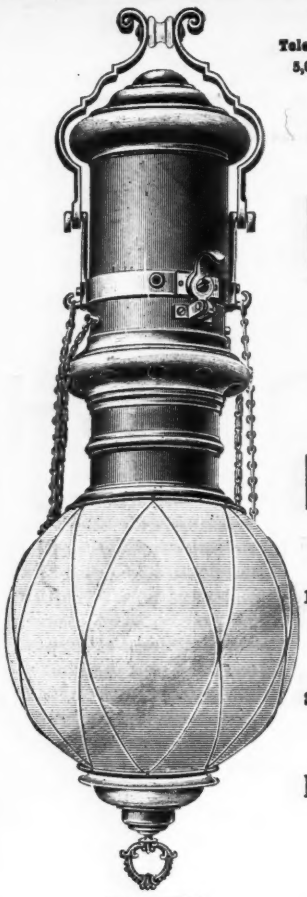


BELL.

As supplied to G.C. (M.S. & L.) Railway Co.

Switch Bases to any Design. Screws and Terminals for all purposes.

F



Telephone No 5,075 Bank.

G. BRAULIK,

217 & 218, Upper Thames St., Old Swan Lane, E.C.

Telegrams: "BRAULIK, LONDON."

PERFECTION AT LAST!

IMMENSE SUCCESS

OF THE

KOERTING & MATHIESEN

LONG DURATION

ENCLOSED ARC LAMP,

PATTERN J-V,

(Made under License),

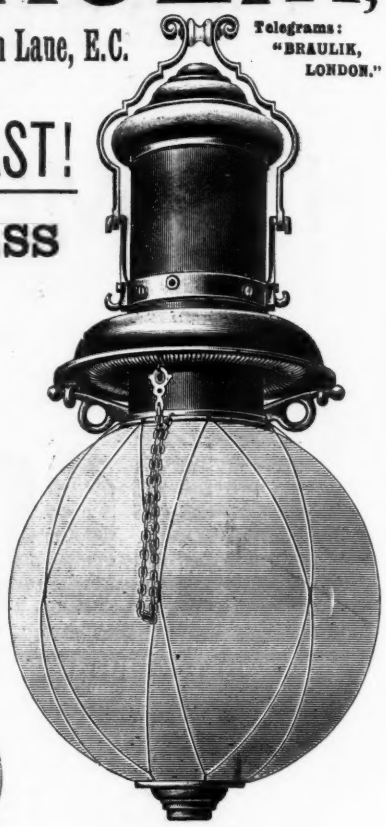
100—200 hours; 3—7 amperes; burns singly on 100—110 volts, and in series on 200—230 volts.

SEND FOR PRICES AND FULL PARTICULARS.

LARGE STOCK KEPT IN LONDON.

New Descriptive Price List Ready Shortly.

THE BEST HOUSE FOR ALL ELECTRICAL ACCESSORIES.



XXXVIII d.
A handsome and well-finished Cover, suitable for inside or outside use.

XXXIX d.
A well-made and strong Cover, fitted with spiral resistance inside.

Telegrams: "BRAULIK, LONDON." Telephone No. 5,075, Bank.

G. BRAULIK,

217 & 218, Upper Thames St., Old Swan Lane, &c., &c.

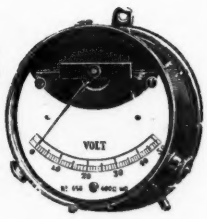
Established over 10 years.

WINTER SEASON, 1897-8.

LARGE and WELL-ASSORTED STOCK of "LONDON" Volt & Ampere Meters.

FIRST-CLASS QUALITY ONLY.

In Brass Cases, Silver Face, Enamelled Dial, Alternating and Continuous Currents, suitable for Schools, Colleges, Technical Institutions, Central Stations, Laboratory, Switchboard, and Accumulator Work.



AMPERES.	6-in. dial.	8-in. dial.
10, 15, 20, 25, 30, 40, 50, 60, or 80 amps.	36s. ..	40s.
100, 120, or 150	38s. ..	42s.
200, 250	38s. ..	45s.
300	40s. ..	48s.
400	45s. ..	50s.
500	50s. ..	55s.

CHEAP AT DOUBLE THE PRICE. TRIAL ORDER SOLICITED. APPROVAL IF NECESSARY.

VOLTS.	6-in. dial.	8-in. dial.
5, 10, 20 volts ..	40s. ..	45s.
30, 40, 50	42s. ..	48s.
5, 100, 125	44s. ..	50s.
150 or 175	46s. ..	52s.
200	50s. ..	60s.
250	55s. ..	65s.
300	60s. ..	70s.
400	70s. ..	80s.

LIBERAL DISCOUNT ACCORDING TO QUANTITIES.

THE FOWLER-WARING CABLES COMPANY LIMITED.

110 FENCHURCH STREET. E.C.

ALL CLASSES OF VULCANIZED AND PURE INDIA RUBBER WIRES AND CABLES.

Sole Manufacturers of

LEAD-COVERED CABLES

UNDER THE COMPANY'S PATENTS

FOR TELEPHONE, TELEGRAPH, ELECTRIC LIGHT, TRANSMISSION OF POWER,

And Underground Installations of every kind.

SPECIAL ANTI-INDUCTION TELEPHONE CABLES.

UNAFFECTED BY HEAT
MECHANICAL STRENGTH
HIGH INSULATION,
LOW CAPACITY

STEAM SHIPS, DOCKS,
CHEMICAL WORKS,
FACTORIES. MINES
DAMP PLACES, &c.

GOLD MEDAL, PARIS EXHIBITION.

References & Particulars on Application.

WORKS: NORTH WOOLWICH E.

UNIVERSAL ELECTRICAL DIRECTORY
(J. A. BERLY'S).
6s.

DO YOU ADVERTISE IN IT?

If not, the 1898 issue is now in preparation.
RATES ON APPLICATION.
"UNIVERSAL" IN SCOPE AND IN CIRCULATION.

London: H. ALABASTER, GATEHOUSE & CO.,
4, LUDGATE HILL, LONDON, E.C.

Now Ready. Price 2s.

ELECTRIC TRAMWAYS & RAILWAYS

POPULARLY EXPLAINED,

BY

H. SCHOLEY,

Assistant Editor "ELECTRICAL REVIEW."

This work, which is beautifully illustrated, is designed to give in popular language an account of the progress of Electric Traction. The chief methods of employing electricity for traction purposes are explained, while the most noteworthy foreign and Continental systems are described and illustrated.

It will be of great use to Members of Municipal Authorities and Tramway Companies who are considering the question of adopting Electric Traction.

It is interesting to the general public, because English systems are for the first time popularly explained.

PUBLISHED BY

H. ALABASTER, GATEHOUSE & CO.,

4, LUDGATE HILL, E.C.

POST FREE, 7s. 6d.

Applied Magnetism:

AN INTRODUCTION TO THE DESIGN OF ELECTRO-MAGNETIC APPARATUS.

By J. A. KINGDON, B.A., formerly Math. Schol., Pemb. Coll., Oxon.

75 ILLUSTRATIONS, MANY ORIGINAL; SEVEN TABLES.

CONTENTS.—Chap. I., General Principles of Magnetism; Chap. II., The Electromagnetic Units; Chap. III., Magnetomotive Force of Current; Chap. IV., Magnetic Traction; Chap. V., Generation of Electromotive Force; Chap. VI., Qualitative Magnetism; Chap. VII., The Alternator; Chap. VIII., The Dynamo; Chap. IX., Magnets and Magnetic Leakage; Chap. X., Commutators and Collectors; Chap. XI., Hysteresis and Heating of Armatures; Chap. XII., Alternating Magnetic Flux; Chap. XIII., Electromotors; Chap. XIV., Polyphase Currents and Rotary Fields; Chap. XV., Magnetic Measurements; Chap. XVI., Calculations in Inch Measures. Appendices:—I., Dimensions of Fundamental, Derived and Electromagnetic Units; II., Symbols and Formulæ. Index.

H. ALABASTER, GATEHOUSE & CO., 4, LUDGATE HILL, LONDON, E.C.

35 ILLUSTRATIONS. 2s. 6d. POST FREE.

OZONE: ITS COMMERCIAL PRODUCTION AND ITS APPLICATIONS.

BY EMILE ANDREOLI.

CONTENTS.—Bunsen and Faraday on the Properties of Ozone; From Schönbein to W. Siemens; Dr. Werner Siemens, 1857, and the first experimenters; Von Babo, 1863; Beanes and Ladd, 1868; Ladd and the yield of Ozone, Houzeau, 1872—knowlege of the Nature of Ozone; Boillot, 1873—the Ozonisation of Air; Tisley, 1873—Ozone preserves perishable provisions; Berthelot electrifies liquids; Dr. W. Spottiswoode and Ward, 1875; Progress of Ozone; Medical and other properties of Ozone; Brin Brothers, 1886; Burgundy wines and brandies ozonised; Dr. de Vars, 1889, and Berthelot; Experiments on the properties of Ozone; Séguy—More glass tube ozonisers; Guénet, 1891; Drs. Labbé and F. Oudin, Medical Ozonisers; Dr. Girerd Inhaler; Siemens and Halske, 1891; Dr. Fröhlich, his experiment; Ozonisation of water, oxonised air in theatres, &c.; Schneller and Wisse, 1891; Fahrig and Schneller, Andreoli, 1892-93, the first open ozonisers; Miscellaneous in 1892; Commercial ozonisers: Villon ozoniser; D. Korda, 1892; Andreoli, 1893, commercial production of Ozone; Maturing and Improving wines and spirits; Experiments and applications; Bleaching; Oils oxidised and bleached; Purification of water; Oxidation of organic substances; Ozone, a powerful disinfectant; Ozone and cholera; Ozone judged by the German Sanitary Board; Bibliography; Analytical Index.

H. ALABASTER, GATEHOUSE & CO., 4, Ludgate Hill, London.

NALDER BROTHERS & THOMPSON,

SUCCESSORS IN THE

AMMETER, VOLTMETER, AND SWITCH BUSINESS

TO

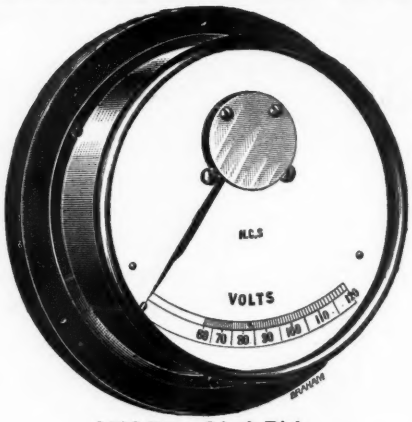
NALDER BROS. & CO.,

16, RED LION STREET, CLERKENWELL, E.C.

SOLE MAKERS OF THE

N.C.S. AMMETERS & VOLTMETERS.

HIGH INSULATION,
6-INCH METAL DIAL,
BRASS COVER, BRASS BASE,
TERMINALS AT BACK.



JEWELLED BEARINGS,
ACCURATE, RELIABLE, HANDSOME.
MADE IN ENGLAND.

1896 Type, 6-inch Dial.

£1 17 6 UP TO **100** AMPS. **£2** UP TO **160** VOLTS.

SOLE ADDRESS:

34, QUEEN STREET, CHEAPSIDE, LONDON, E.C.

AGENTS:—Messrs. W. McGEOCH & Co., 108, Argyle Street, Glasgow; and Mr. S. JEVONS, Electric Stores, Minories, Birmingham. a160

GILBERT'S LUXURY.

Patents 6115/96—10633/97

POST FREE. 10/6 COMBINATION CIGAR AND CIGARETTE HOLDER. A FIRST-CLASS ARTICLE.

POST 10/6 FREE.

THE SWEETEST, COOLEST, LIGHTEST, AND EASIEST CLEANED LITTLE PIPE THAT ANY MAN COULD WISH TO SMOKE. THE RESULT OF 20 YEARS' EXPERIENCE OF A GREAT SMOKER.

AIR

LARGER PIPES IN STOCK

QUITE IMPOSSIBLE FOR ANYTHING OTHER THAN THE AMBROSIAL SMOKE TO REACH THE MOUTH, THEREBY AVOIDING IRRITATION TO THE THROAT, SLOW POISONING, AND DISTURBANCE OF THE NERVOUS SYSTEM. POSITIVELY THE BEST PIPE EVER INVENTED A NICE PRESENT FOR CHRISTMAS

CLEANED SIMPLY WITH ROD AND WORSTED.

POST 8/6 FREE.

AIR

Arthur E. Gilbert, A.I.E.E.

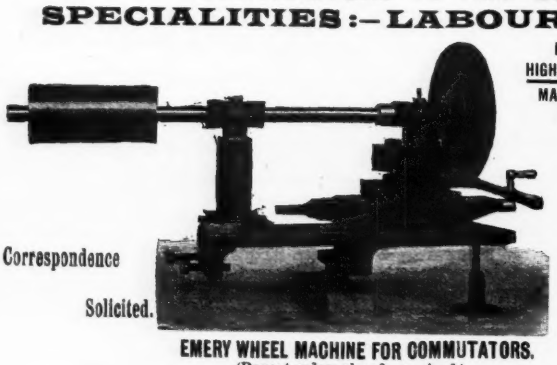
23 King John Terrace, Heaton, NEWCASTLE-ON-TYNE.

HONEYWOOD, AUSTIN & CO., GENERAL ENGINEERS,

CONTRACTORS TO H.M. GOVERNMENT.

SPECIALITIES:—LABOUR-SAVING TOOLS.

Correspondence Solicited.



EMERY WHEEL MACHINE FOR COMMUTATORS.
(Repeat orders already received.)

MAKERS OF THE MOST PERFECT HIGH-PRESSURE FULL-WAY VALVE IN THE MARKET. SPECIALLY SUITABLE FOR ELECTRIC LIGHT STATIONS.

GROVE WORKS, HARLEYFORD ROAD, VAUXHALL, LONDON.

TO MANUFACTURERS OF DYNAMOS, MOTORS, TRANSFORMERS, &c.

STAMPINGS OF ALL DESCRIPTIONS, | **MAGNETS—Forged, Rolled, Cast or Stamped, Finished, or in the Rough.**

DISCS up to 60 inches diam.

SLOTTED WORK a specialty.

Accuracy of Stamping and Highest Electrical Results Guaranteed.

SLABS & BARS in Suitable Sections for Magnets, Cold Sawn to lengths.

ROLLED AND FORGED SHAFTING, EYE BOLTS MICA, COMMUTATOR SEGMENTS, &c. 1943

ROBERT JENKINS,

88, BISHOPSGATE ST. WITHIN, LONDON, E.C.
Telegraphic Address:—"Permeable, London."

Official Notices.

CORPORATION OF LONDONDERRY.

THE CORPORATION OF LONDONDERRY invite tenders for the supply of Carbons for one year from January 1st, 1898.

Schedules of quantities, and further particulars may be obtained on application to Mr. JOHN CHRISTIE, City Electrical Engineer, Guildhall, Londonderry.

Tenders, accompanied by samples, marked "Tender for Carbons," to be lodged with him, not later than THURSDAY, DECEMBER 9th, 1897.

R. NEWMAN CHAMBERS,
Town Clerk.

Guildhall, Londonderry,
November 17th, 1897. 1973

COUNTY BOROUGH OF BARROW-IN-FURNESS.

ELECTRICITY SUPPLY.

CONTRACT No. 2.

THE CORPORATION OF BARROW-IN-FURNESS invite Tenders for the supply and erection of:—

Section A.—Boilers, Pumps, Steam and Water Pipes, Tank, Crane, Economiser, Iron Work.
Section B.—Engines, Generators, Switchboards, Instruments, Accumulators, Motor Transformers, Sub-Station Equipments.
Section C.—High and Low Tension Feeder and Distributor Cables, House Connection Boxes.
Section D.—Conduits, Drawing-in Boxes.

Specifications and forms of tender can be obtained on and after November 26th, 1897, at the Town Hall, Barrow-in-Furness, or at the Offices of the Engineers, Messrs. Kincaid, Waller & Manville, 29, Great George Street, Westminster, on payment of a fee of £3 3s., which sum will be returned on receipt of a *bond fide* tender. The contractor will be required to pay the rate of wages and observe the hours of labour recognised and agreed upon between the Trades' Unions and the employers respectively in the locality in which the work for carrying out the contract is to be performed, or such rate of wages and hours as are equivalent or approximate thereto.

Contractors may tender for any one of the sections, or the four sections complete, but the Corporation will not consider any tender for a part of a section only.

The Corporation do not bind themselves to accept the lowest or any tender, and the contractor whose tender is accepted shall enter into a formal agreement, under seal, with sufficient sureties for the due fulfilment of his contract.

Sealed tenders, endorsed "Electricity Supply, Contract No. 2," must be sent to me at or before 12 o'clock noon on WEDNESDAY, DECEMBER 15th, 1897.

By Order,
C. F. PRESTON,
Town Clerk

Town Hall, Barrow-in-Furness.
November 24th, 1897. 2015

BOROUGH OF TUNBRIDGE WELLS.

ELECTRICITY DEPARTMENT.

ENGINE DRIVER required accustomed to Willans's engines and Babcock boilers, to take shift duty, and repairs. Wages, 32s. per week. Apply, giving experience, to

H. L. P. BOOT,
Borough Electrical Engineer.

Town Hall,
Tunbridge Wells. 2045

Official Notices.—*Continued.*

CITY OF SHEFFIELD.

Resident Electrical Engineer—Tramways.

THE TRAMWAYS COMMITTEE of the Sheffield Corporation invite applications for the post of Resident Electrical Engineer in connection with the reconstruction of certain of the existing tramways into the electric overhead system and the construction of extensions of tramways on the same system.

The gentleman appointed will be required to devote the whole of his time to the duties of the office, and will have to superintend and carry out the electrical equipment of the various lines and extensions, and also the working of the same.

Candidates must state their age, qualifications, experience salary required, and when the duties could be commenced.

Personal canvassing will disqualify.

Applications to be sent in to me on or before MONDAY, DECEMBER 13th, marked "Resident Electrical Engineer."

H. SAYER,
Town Clerk.

Town Hall, Sheffield,
December 1st, 1897. 2047

VESTRY OF ST. MARY, ISLINGTON.

ELECTRICITY SUPPLY.

WANTED AT ONCE, an Engine Driver at the Vestry's electric lighting works. Wages 7½d. per hour for an average seven days' week of 56 hours. Written applications, with copies of not more than three recent testimonials, to be sent to the Electrical Engineer, 50, Eden Grove, Holloway, N., and to be received by him not later than 12 o'clock noon, on TUESDAY, DECEMBER 7th, 1897.

Personal canvassing will disqualify. Applications to be endorsed "Engine Driver" on the outside.

(Signed) W. F. DEWEY,
Vestry Clerk.

Vestry Office, Upper Street, N.
November 27th, 1897. 2034

COUNTY BOROUGH OF NEWPORT.

THE CORPORATION are prepared to receive tenders for an Electric Lighting Plant for temporary lighting at Wentwood Waterworks. The plant will be required to light about 350 16-candle power lamps, or their equivalent. Oil or steam driven machines may be tendered for. Secondhand plant preferred. Further particulars may be had upon application to the Borough Engineer, Newport.

Tenders, marked "Electric Light Plant," must be delivered at my office before 10 a.m. on DECEMBER 15th next.

Dated November 29th, 1897.

ALBERT A. NEWMAN,
Town Clerk.

Town Hall, Newport. 2036

BOROUGH OF DEWSBURY.

ELECTRICITY DEPARTMENT.

THE CORPORATION OF DEWSBURY have vacancies for Two Improvers at their electricity supply station. Applicants must state experience and salary required.

Applications, accompanied by two testimonials of recent date, and endorsed "Improver," to be sent addressed to me at the Town Hall not later than THURSDAY the 9th inst.

G. TREVELYAN LEE,
Town Clerk.

Town Hall, Dewsbury,
November 30th, 1897. 2037

[*Continued on next Page*]

Official Notices.—*continued.*

WOLVERHAMPTON CORPORATION.

ELECTRIC LIGHTING.

JUNIOR ASSISTANT.

THE LIGHTING COMMITTEE invite applications for the post of Junior Assistant in the office of the Borough Electrical Engineer at a salary of £80 per annum.

Candidates to apply upon a form to be obtained from the undersigned, to whom the same, duly filled in, must be returned on or before DECEMBER 8th.

By Order,

F. HARMAN LEWIS,
Borough Electrical Engineer.

Town Hall, Wolverhampton.
November 23rd, 1897. 2018

LANCASTER CORPORATION.

THE ELECTRICITY COMMITTEE have a vacancy for a Pupil at their electric light works, for a period of two years, at a premium of £25 per annum. Candidates must not be under 18 years of age. Further particulars may be obtained on application to the Borough Electrical Engineer.

Applications, stating age and full particulars, endorsed "Pupil," to be sent to the undersigned on or before THURSDAY, DECEMBER 9th.

T. CANN HUGHES,
Town Clerk.

Town Hall, Lancaster.
November 23rd, 1897. 2014

VESTRY OF ST. PANCRAS.

THE VESTRY OF ST. PANCRAS invite Tenders for the supplying and erecting of Arc Lamps, Posts and Circuits complete, also Feeding and Distributing Mains.

Copies of specification, conditions of contract, and form of tender, to be obtained upon application to the Chief Clerk, Electricity Department, offices 57, Pratt Street, N.W., on payment of a deposit of £1, which will be returnable on receipt of a *bona fide* tender, accompanied by the specification.

Tenders to be sent to the undersigned, endorsed "Tender for Arc Lighting Extensions," by 12 o'clock noon, on TUESDAY, DECEMBER 28th, 1897.

The Vestry do not bind themselves to accept the lowest or any tender.

C. H. F. BARRETT,
Vestry Clerk.

Vestry Hall, Pancras Road,
London, N.W., *November 29th*, 1897. 2035

VESTRY OF ST. JOHN HAMPSTEAD.

Assistant Electrical Engineer Wanted.

THE VESTRY are prepared to appoint an Assistant Electrical Engineer to take charge of the running of their electric light station on one of the shifts, and to carry out the instructions of their chief engineer.

He must have had practical experience of alternating current station work (preferably with Siemens's and Ferranti's alternators and Willans's engines), including synchronising, running in parallel, indicating engines, and testing alternators and cables, getting out cost sheets, efficiencies, &c. He will be required to reside in the parish, and must not engage in any other business or employment. Salary at the rate of £2 5s. per week.

Applications, stating age and previous experience, together with copies of not more than three testimonials of recent date, to be sent in to me not later than 10 a.m. on DECEMBER 13th next.

By Order,

ARTHUR P. JOHNSON,
Vestry Clerk.

Vestry Hall, Hampstead,
November 30th, 1897. 2042

Official Notices.

BOROUGH OF WORTHING.

THE Electric Light Committee of the Town Council invite particulars and conditions under which any person, firm, or company, is willing to instal and maintain the electric light in the Borough for a term of years, with power to the corporation to acquire the undertaking upon agreed terms and at stated periods. The provisional order of the Board of Trade, which is in the usual form, may be inspected, and a plan of the town, showing the compulsory area and other particulars, obtained on application at the Town Clerk's office, Liverpool Road, Worthing.

W. VERRALL,
Town Clerk.

Worthing, *December 1st*, 1897. 2057

Educational Notice.

THE ELECTRICAL & GENERAL ENGINEERING COLLEGE,

PENYWERN HOUSE, EARL'S COURT.

Principal: G. W. de TUNZELMANN, B.Sc. M.I.E.E. | *Senior Instructor* C. CAPITO, M.I.E.E., M.I.M.E.

Extensive Laboratories, Testing Rooms, Dynamo Room, Steam Engine, Workshops.

Recommended by most of the leading engineering firms. 114

IMPROVED ELECTRICAL APPARATUS

FOR TECHNICAL SCHOOLS AND COLLEGES.

L. M. WATERHOUSE, A.I.E.E.,

Lecturer in Electrical Technology, Croydon County Polytechnic,

Catalogue for Session 1897-98, on application. 5, BIRDHURST ROAD, CROYDON. 1982

Just Published. SIXTH EDITION, REVISED WITH ADDITIONAL CHAPTERS, Crown 8vo, 7s. 6d., Cloth.

ELECTRIC LIGHT:

ITS PRODUCTION AND USE.

By JOHN W. URQUHART, Electrician.

Also by the same Author.—THIRD EDITION, REVISED WITH FURTHER ADDITIONS, Crown 8vo, 5s. Cloth.

ELECTRIC LIGHT FITTING:

A HANDBOOK FOR WORKING ELECTRICAL ENGINEERS,

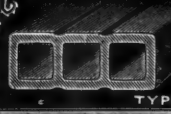
Embodying Practical Notes on Installation Management.

London: CROSBY LOCKWOOD & SON, 7, Stationers' Hall Court, E.C. 2118

PAUL Electrical Instruments.
44, HATTON GARDEN, E.C.
Catalogues Free.
Vide Full Advertisement in last issue also next issue. 828

ADOPTED AT EDINBURGH, SUNDERLAND, SHOREDITCH, LEYTON, BEDFORD, PRESTON, CHELMSFORD, BRADFORD, PORTSMOUTH MANCHESTER, EASTBOURNE, STAFFORD, ST. PANCRAS, WAKEFIELD, KILLARNEY, &c., &c

And by the London Supply Companies.



VARIOUS TYPES AND SIZES KEPT IN STOCK.

THE PATENT

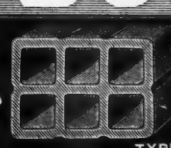
DOULTON CONDUITS

FOR UNDERGROUND ELECTRIC MAINS

DOULTON & CO., Lambeth, LONDON, S.E.

WORKS: LAMBETH, LONDON, S.E. OWLEY REGIS, STAFFS. SMETHWICK, nr. BIRMINGHAM. ST. HELEN'S, LANCS. BURSLEM. | PAISLEY, N.B. PARIS.

DEPOTS: BIRMINGHAM, Granville St. LIVERPOOL, Soho St. MANCHESTER, Deansgate. GLASGOW, Bothwell St. PARIS, Rue de Paradis.



a398

R TYPE
STORAGE BATTERIES

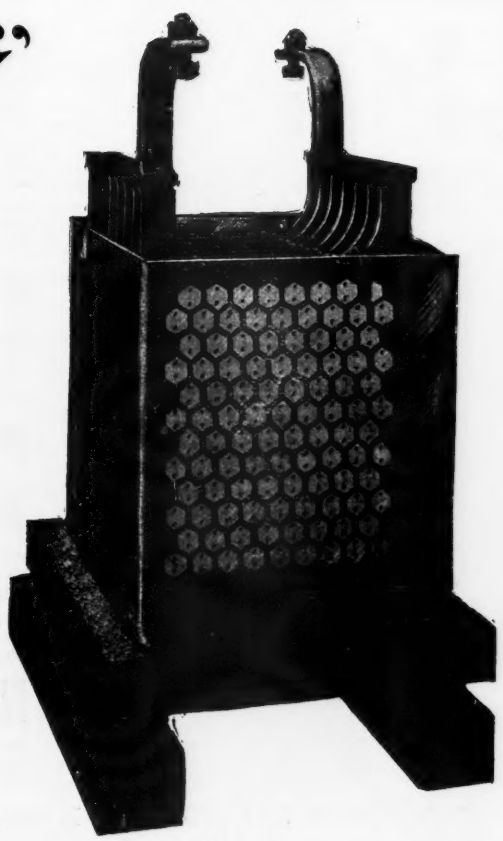
FOR

CENTRAL STATION,

As adopted by the following

CORPORATIONS:

Manchester,
Stafford,
Oldham,
Bolton,



Carlisle,
Halifax,
Lincoln,
Morley,
Leeds.

The Chloride Electrical Storage Syndicate,

Limited,

Clifton Junction,

Near Manchester.

London Office:

39, Victoria Street, S.W.

1720

"HUNNINGSCONE DECKERT."

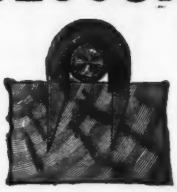
"HUNNINGSCONE DECKERT."

INTERCOMMUNICATION TELEPHONES

REGD TRADE MARK

AND ALL ACCESSORIES.

FLEXIBLE CORD for TABLE SETS, &c.

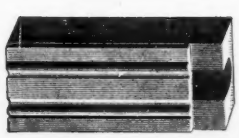


INSULATED STAPLES FOR CABLE.

MULTIPLE CABLE.

"HUNNINGSCONE." DECKERT PATENT

CONNECTING BOX.



SINGLE GROOVE CASING FOR CABLE.

LIBERAL TRADE DISCOUNTS.

ALL INSTRUMENTS AND ACCESSORIES IN STOCK.

COMPLETE STATION (No. K 50b.),
With Backboard and Battery Box. 20 Lines.

£4 1s. 0d.

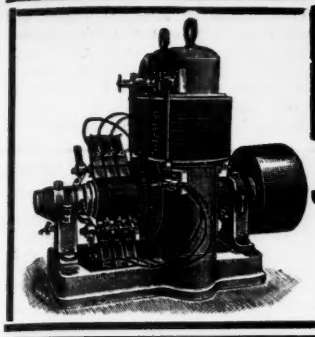
THE GENERAL ELECTRIC CO.

LIMITED.

HEAD OFFICES AND SHOWROOMS—
69, 71, & 88, Queen Victoria Street, LONDON, E.C.

Branches—45, Chapel Street, Manchester.
71, Waterloo Street, Glasgow.
39, Corporation Street, Birmingham.
13. Westgate Road. Newcastle-on-Tyne.
9, William Street, Dublin.

Works—Peel Works, Adelphi, SALFORD.
Great Hampton Street, BIRMINGHAM.
Brook Green, HAMMERSMITH.
CLERKENWELL. 1127



"CASTLE"

SLOW SPEED.
HIGH EFFICIENCY.

J. H. HOLMES & CO.,
NEWCASTLE-ON-TYNE,
AND
17, SOHO SQUARE W.

DYNAMOS

1121

THE ELECTRICAL REVIEW.

PUBLISHED EVERY FRIDAY, PRICE 4d.
Office: 4, LUDGATE HILL, LONDON.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY

NOTICE TO ADVERTISERS.

The following are the LATEST times up to which Advertisements can be received for publication in current week's issue:—

New Advertisements, or Alterations to existing ones, Wednesday 2 p.m.
Small Announcements for middle pages, Thursday 2 p.m.

TELEPHONE No. 14,977 Telegrams: "INDICES," LONDON.

WHEATLEY KIRK, PRICE & GOULTY

(ESTABLISHED 1880),

Electrical Auctioneers, Valuers,

AND ARBITRATORS.

Average Annual Valuations exceed £1,500,000 Sterling.

49, QUEEN VICTORIA STREET, LONDON E.C.

a3291

CHEAP PREPAID ADVERTISEMENTS,

Relating to *Situations Vacant, Situations Wanted, Businesses Wanted, Businesses for Sale, Patents for Sale, Specific Articles of any kind Wanted, or for Sale or Exchange, are inserted at the rate of* ONE PENNY *Per Word (minimum* 1s.).

Three consecutive Insertions for the Price for Two.

*** This Scale does not apply to Trade Advertisements, terms for which can be had on application.

SITUATIONS VACANT.

Where Advertisements are to be answered to a given number, letter, or *nom de plume* at the ELECTRICAL REVIEW Office, applications for names and addresses of the Advertisers will be entirely disregarded.

Original Testimonials should never be sent.

A YOUNG MAN Wanted to assist in the practical construction of electric motor cars. Must be prepared to invest £1,000 in the business.—Apply 2,027, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2027

AGENTS.—Old-established manufacturing firm of everything electrical, requires a live Agent in every important town in England. Business men having extensive connection will be treated with on liberal terms.—1,756, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 1756

FIRST-CLASS Mechanical Draughtsman Wanted, used to boilers and engines and general design; knowledge of electrical work desirable, but not essential.—Apply, stating salary desired, 2,023, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2023

FOREMAN required, also several hands thoroughly up in arc lamp making and testing.—Reply, stating age, wages required, experience, and references, to 1,954, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 1954

JUNIOR Assistant Engineer Wanted to take charge of light shift.—Apply MANAGER, Electricity Works, New Brompton, Kent. 2046

SWITCH MAKER Wanted, one used to experimental work preferred, non-society.—Apply 2,029, ELECTRICAL REVIEW, 4, Ludgate Hill, London 2029

TESTING INSTRUMENTS.—Foreman wanted in shop doing varied work. Permanent and improving position for an energetic mechanic and good organiser. Apply fully (in confidence). Also vacancy for a good Improver (about 20s.), and a few Instrument Makers (piecework).—1,871, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 1871

WANTED.—Assistant in electrical works, good knowledge arc lamp trade indispensable.—Apply, stating experience and salary required, to 2,038, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2038

WANTED.—A Young Electrician capable of testing installations and carrying out repairs, permanency for suitable man.—Apply by letter, stating full particulars and wages required, to 2,055, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2055

VULCANITE.

HARBURG INDIA-RUBBER C. COMPANY.
London Warehouse: F. WINTER, 138, London Wall, Wood St., E.C.

EBONITE.

1119

WANTED.—First-class Wiremen, lighting, bells, telephones.—FURSE Nottingham. 2040

WANTED.—A young energetic Man with good knowledge of the electrical trade in all its branches as Traveller, to represent a first-class firm of commission merchants.—Full particulars as to age, salary required, references, &c., to be addressed to "ELECTRO" at Horncastle's, 61, Cheapside, E.C. 2058

WANTED.—An Assistant for testing, also several Instrument Makers, and two or three handy men. All for arc lamp factory, and all non-society.—Apply JOHNSON & PHILLIPS, Victoria Works, Charlton, Kent. 2008

SITUATIONS WANTED.

Where Advertisements are to be answered to a given number, letter or *nom de plume* at the ELECTRICAL REVIEW Office, applications for names and addresses of the Advertisers will be entirely disregarded.

A.I.E.E., eight years' experience dynamo and motor design and construction, estimating, control of men, installations, and business experience, seeks re-engagement as Manager.—2,056, ELECTRICAL REIEW, 4, Ludgate Hill, London. 2056

AN Italian Gentlemen, civil mechanical engineer, at present with a well-known English firm, shortly returning to Italy, is willing to act as Agent for machinery manufacturers of every description; highest references.—Please address 2,041, care of ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2041

ACCOUNTANT.—Mr. A. E. Evans, formerly of the International Electric Company, late of H. M. Salmony & Co, is open to an appointment as above.—Address, London Road, Romford. 2011

DRAUGHTSMAN, with good experience in engineering and electrical drawing office practice, desires situation in drawing office of electrical engineering firm of good standing.—1,992, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 1992

ELECTRICAL ENGINEER will shortly be open to engagement; well up in engine room economies, steam and gas power plants, every description of arc and incandescent lighting and installation work.—Apply, 2,001, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2001

ELECTRICIAN (22) desires post as Assistant or Improver in central station. Two years shop and one year high tension station; good references.—2,019, ELECTRICAL REVIEW, 4, Ludgate Hill London. 2019

ELECTRICAL Instrument Makers.—Wanted to Apprentice lad to the above.—Apply, stating premium and full particulars, 2,051, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2051

ELECTRIC LIGHTING.—Young gentleman well up in installation work, theoretically and practically, desires permanent engagement after Christmas. Salary secondary consideration.—2,048, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2048

ELECTROLIER ARTIST requires evening home work exhibition prize winner; effective designing at very moderate terms; splendid testimonials received.—"DESIGNER," 41, Caversham Road, N.W. 2026

ELECTRICIAN, good mechanic, engaged part of day, wants job at theatre or elsewhere in the evening, at liberty after three o'clock, moderate salary.—"VOLT," 145, Railton Road, Herne Hill. 2062

ELECTRICAL ENGINEER (30) with 14 years' shop, drawing office and commercial experience in dynamo and fittings manufacturers, seeks engagement as Assistant Manager.—2,033, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2033

[*Continued on next page.*]

ELECTRICIAN open for any engagement, practical in dynamos, accumulators, switchboards, instruments, or any experimenting, and installation work in lighting and bells; first class references; 16½ years' experience.—2,044, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2044

ELECTRICAL ENGINEER, age 24½, at present mains superintendent to a large provincial company, requires situation at home or abroad; six years' practical and two years' theoretical experience.—1,953, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 1953

ELECTRICAL ENGINEER (21), seeks responsible berth, used to installation, erection, testing.—"C," 71, Sheen Road, Richmond, Surrey. 1959

ELECTRICAL ENGINEER (25), desires engagement as Assistant, or charge of plant, two years' experience in large steamship company as sea-going electrician-in-charge. Previous technical training in all branches.—"C. L," 47, Finsbury Sq. 1976

ELECTRICIAN (24) requires engagement (experience) two years in large central station, five years in dynamo works, fair draughtsman, holds first-class technical certificates, excellent testimonials.—"ELECTRICIAN," 253, Westbourne Grove, London, W. 1964

ELECTRICIAN, having had thorough technical education and four years' practical experience (charge of men and machinery), desires re-engagement. Preferable charge of direct current station, or charge of wiring.—"JEUN," care of Isaac Brine, Limited, 105, St. Stephen's Road, Bow, E. 1960

ENGINE DRIVER requires Situation as engine driver to look after small electric plant or lighting station; can do own repairs; good reference.—W. PHILLIPS, 71, Brownlow Road, Queen's Road, Dalston. 1950

GENTLEMAN calling upon and well known to electrical engineers in the West, Midlands, and North of England, is open to represent a first-class house on commission.—2,007, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2007

TO CONTRACTING ENGINEERS.—Electrical Engineer desires re-engagement, estimating superintending all kinds of electrical work.—"A.I.E.E," "Meadowhurst," North Finchley. 1974

WIREMAN seeks engagement (country preferred); used to "Conduit" system; good references.—Address, "CONDUIT," 106, Tunis Road, Shepherd's Bush, London. 2013

WIREMAN'S ASSISTANT, good joiner, seeks employment.—"B. R," 164, Long Lane, Bermondsey. 2054

WIREMAN seeks employment, 7d. hour.—"H. H," 10, Methley Street, Kennington, S.E. 2058

WANTED, by a mechanical electrician with scientific attainments, position with established firm or company where his extensive experience of workshop management will be of service. Could introduce capital into a sound business.—Apply, 1 986, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 1986

WIREMAN EXPERT.—Thorough engineer, used to foremanship, free to engage immediately; highest references.—2,024, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2024

ARTICLES FOR SALE AND WANTED, PARTNERSHIPS, &c.

Where Advertisements are to be answered to a given number, letter, or nom de plume at the ELECTRICAL REVIEW Office, applications for names and addresses of the Advertisers will be entirely disregarded.

ACCUMULATOR Charging.—C. H. Cathcart & Co., having plant specially adapted for this purpose, charge cells of all sizes promptly, thoroughly, and cheaply. Terms on application. Accumulators on hire for temporary lighting, experimental uses, &c.—3, Dorset Buildings, Salisbury Square, Fleet Street, E.C. (Telephone No. 65,266). 7385

ELECTRICAL CONTRACTORS, with first-rate prospects, require partner with capital to enable them to cope with increasing business, or would amalgamate with sound existing business with superfluous capital.—Principals or solicitors only, to 2,050, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 2050

LESSONS BY CORRESPONDENCE in Electric Light and Power Engineering, based on City and Guild's requirements. Preliminary Course, 12 lessons, 6s. 6d. Ordinary Grade, "Course A," 15 lessons 10s. Honours Grade (Central Station Working and Transmission of Power Installations), Course B, 20 lessons 25s. For syllabus and full particulars, apply, "ENGINEER," 83, St. Dunstan's Road, Hammersmith, London, W. 1583

PLATINUM in any form and quantity, purchased at highest prices by DEBBY & Co., 44, Clerkenwell Road, London. 6923

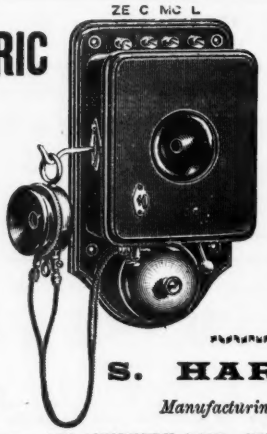
WANTED.—Dynamo about 50 volts, 30 amps.; particulars, lowest price, 94, Baron's Court Road, West Kensington. 2052

WANTED, Electric Lamp Tops and Scrap Platinum.—EDEY AND Co., 29, Ludgate Hill, London. 1966

ELECTRIC Bells, Pushes, Lamps, Wires.

PRICE LIST OF ELECTRICAL ACCESSORIES ON APPLICATION

Liberal Discounts to the Trade.



Telephones, Batteries, Switches, Electro-Medical Apparatus.

S. HARRISON,

Manufacturing Electrician,

Office—697, ORMSKIRK ROAD, PEMBERTON, WIGAN.
Works—ELLESMERE MILL, NEWTOWN, WIGAN.
Registered Telegraphic Address:—"HARRISON, PEMBERTON." 1107

JOHNSON & PHILLIPS,

14, Union Court, Old Broad St., E.C., and Charlton, Kent.

MAKERS of the most modern machines for
CABLE MAKING. | CABLE LAYING.
STRANDING. | BRAIDING.
TAPING. | WINDING.
COMPOUNDING. | LAPPING.
RUBBER, SILK & COTTON COVERING 1386

Mr. J. G. LORRAIN, M.I.E.E., M.I.M.E. &c.
Fellow of the Chartered Institute of Patent Agents,
Norfolk House, Norfolk St., London, W.C.
"PATENTEE'S HANDBOOK" Post Free on Application. 1137

L. GARDNER & SONS, DYNAMOS, MOTORS
MANCHESTER GAS ENGINES.
See Page Advertisement Third Friday of each month.

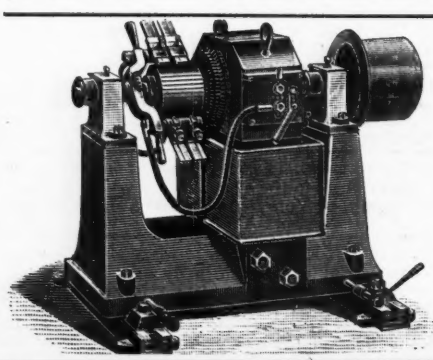
THE
EMISSARY PATENT ELECTRICAL LUBRICANT.

REGISTERED TRADE MARK:
EMISSARY

Absolutely prevents all Sparking Heating, and Friction on Dynamos Motors, &c. The BEST and CHEAPEST Lubricant.

Commutators and Brushes run for years without any measurable wear. Sample tins, 2s. 6d., post free.

THE KINGFISHER PATENT LUBRICATION CO., LEEDS.
Telegrams, "KINGFISHER." Telephone 1,985. 1560



FLATHER & SON,
ELECTRICAL ENGINEERS,
PARK ELECTRICAL WORKS.
Office and Showrooms:—SPEEDWELL ST., WOODHOUSE CARR, LEEDS.

Makers of
DYNAMOS, MOTORS,
AUTO-CAR MOTORS, &c.
Complete Private Lighting and Transmission of Power Plants for Factories, Hotels, Mansions, &c.
ESTIMATES FREE. WRITE FOR PRICES. TELEPHONE NO. 1,829.

WE ARE NOW SUPPLYING A

SMALL

GAS ENGINE & DYNAMO COMPLETE,

Capable of lighting CONTINUOUSLY

THREE 8-VOLT LAMPS,

OR CHARGING

FOUR 6-VOLT ACCUMULATORS,

AT

£10 10s., subject.

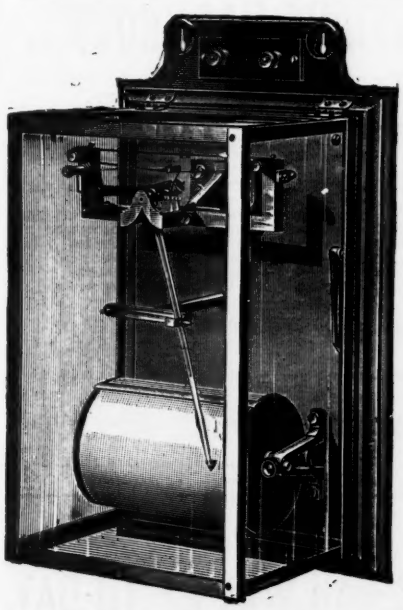
SEND FOR LIST.

H. M. SALMONY & CO.,

MANUFACTURING ELECTRICIANS,

118-120, Charing Cross Road, London, W.C.

Telephone, 5,479, GERRARD. Telegrams:—"SALMONY, LONDON."



RECORDERS,
AMMETERS
VOLTMETERS,
EXCESS INDICATORS,
GALVANOMETERS &c

MINERS' ELECTRIC LAMPS
PORTABLE BATTERIES
LARYNGASCOPES,
CYCLIST'S ELECTRIC LAMPS
SURGEON'S BATTERIES,
X-RAY COIL BATTERIES.

J. PITKIN,

MANUFACTURER,

56, Red Lion St., Clerkenwell, E.C.

Telegrams—"EVERYBODY, LONDON." Telephone—329, KENSINGTON.

J. D. F. ANDREWS & CO., LTD.,

FULHAM ELECTRIC WORKS, PUTNEY BRIDGE STATION, FULHAM, LONDON.

J. D. F. Andrews' Patents

Originators, Pioneers, Patentees, and Perfectors of

SECURITY CONCENTRIC WIRING,

Extensively introduced into every class of building.

SECURITY DOUBLE WIRING,

No wood casing. Same class of work as our Concentric

LONG LIFE ARC LAMPS,

The Pioneer of Great Britain.

Automatic TALK-TO-ALL Telephones.

J. D. F. Andrews' Patents

DYNAMO ATTENDANTS

AND THEIR DYNAMOS.

By Alfred H. Gibbings, A.I.E.E.,

Electrical Engineer to the Bradford Corporation.

A thoroughly practical and useful work, which should be in the hands of every electrical engineer.

OF ALL BOOKSELLERS, 1s., or POST FREE, 1s. 1d., from

S. RENTELL & CO.,

11, Ludgate Hill, LONDON, E.C. 1519

The INDIAN and EASTERN ENGINEER.

AN ILLUSTRATED WEEKLY JOURNAL FOR ENGINEERS IN INDIA AND THE EAST.

The "INDIAN AND EASTERN ENGINEER" contains the latest and most authentic information on all subjects connected with Engineering enterprise in India and the East.

Correspondence invited on any subject which may be of interest to the profession.

RATE OF SUBSCRIPTION (payable in advance, including a copy of the INDIAN AND EASTERN ENGINEER'S DIARY, and postage):—

Indian Rates—Yearly Rs. 20. English Rates—Yearly 40s.

Published at 137, Canning Street, Calcutta.

London Office: 28, *VICTORIA STREET, WESTMINSTER, S.W.* 1881

NOW READY.

ELECTRICAL INSTALLATIONS

FOR ARCHITECTS, BOROUGH SURVEYORS, CIVIL ENGINEERS, &c.

By F. J. WARDEN-STEVENS, A.M.I.E.E., &c.

(Consulting Engineer).

Price 2s. 6d. By Post, 2s. 9d.

"The results of a varied experience in applying electricity—useful to many men who have failed to obtain the information they require in ordinary books."—*The Architect.*

"Practical men who have to supervise installations will find it useful for reference."—*The Scotsman.*

"Essentially for the busy man who desires to pick up something useful about electric lighting. This book will distinctly serve such a purpose."—*Post Magazine.*

London: P. A. GILBERT WOOD, "The Architect," 175, Strand, W.C.

Fully Illustrated. Post Free, 4s. 6d.

THE ELECTRIC RAILWAY

By FRED H. WHIPPLE.

CONTENTS:—Chap. I., Historical Development of the Modern Method of Producing Electricity; Chap. II., How Electricity is Mechanically Produced; Chap. III., Practical Thoughts upon the Lines of Force and the Production of Motion; Chap. IV., Something about Primary and Secondary Batteries; Chap. V., How Electricity is Applied to Street Railways; Chap. VI., The Application of the Motor to the Car; Chap. VII., Early Attempts at Electric Propulsion, with the Roads now in Operation; Chap. VIII., Some of the so-called "Systems" of Electric Street Railways; Chap. IX., Application of Electricity to Elevated and Underground Railways; Chap. X., Cost of Producing, Transmitting, and Applying Electricity for Street Railway Purposes; Chap. XI., Some further Comparisons of Electric Propulsion with other Methods; Chap. XII., The Electric Motor for Stationary Power Purposes; Chap. XIII., The Importance of Economical Steam Power to the Electric Current; Chap. XIV., The Utilisation of Water Powers for Electric Transmission; Chap. XV., The Purchase and Care of Good Belts; Chap. XVI., Conclusion—Some of the Possibilities of Electric Street Car Propulsion.

TO BE OBTAINED FROM

H. ALABASTER, GATEHOUSE & CO.,

4, LUDGATE HILL, LONDON, E.C.

"The representative of advanced science."—*Pall Mall Gazette.*

SCIENCE PROGRESS:

A QUARTERLY REVIEW OF CURRENT SCIENTIFIC INVESTIGATION

Edited by J. BRETLAND FARMER, M.A.,

WITH THE CO-OPERATION OF A POWERFUL EDITORIAL COMMITTEE.

CONTENTS OF THE OCTOBER NUMBER.

SOME PHYSIOLOGICAL ASPECTS OF HYPNOTISM. By FRANCIS GOTCH, M.A., F.R.S., Waynefiete Professor of Physiology in the University of Oxford.

ARTIFICIAL FLIGHT. By G. H. BRYAN, F.R.S., Professor of Mathematics, University College, Bangor.

ON PROGRESS IN THE STUDY OF VARIATION. By W. BATESON, M.A., F.R.S., Fellow of St. John's College, Cambridge.

THE APPLICATIONS OF CRYSTALLOGRAPHY TO PHYSICAL CHEMISTRY By W. J. POPE, Principal of the Chemical Department in the Goldsmith's Institute, New Cross.

THE GERMINATION OF SEEDS. By F. ESCOMBE.

THE GEOLOGY OF MEXICO (with map). By PHILIP LAKE, M.A.

BLOOD AND THE IDENTIFICATION OF BACTERIAL SPECIES. By A. S. GRUNBAUM, M.D.

THE FAUNA OF THE GREAT AFRICAN LAKES. By J. E. S. MOORE, A.R.C.S.

THE POSITION OF SPONGES IN THE ANIMAL KINGDOM: A CORRECTION. By E. A. MINCHIN, M.A., Fellow of Merton College, Oxford.

APPENDIX—REVIEWS OF BOOKS.

Price 2s., or 2s. 3d. post free. Subscription Price 10s. 6d. per annum, post free. Now Ready. Vols. I., II., III., IV., and V., in Handsome Cloth Binding, Gilt Lettered, each containing over 500 pp. Price 15s., each.

London:—

THE SCIENTIFIC PRESS, Ltd., 28 & 29, Southampton St., Strand, W.C.

WHITTAKER'S BOOKS

Illustrated List Post Free on Application.

A MANUAL OF TELEPHONY. By W. H. PREECE, C.B., F.R.S., President of the Institution of Electrical Engineers, Engineer-in-Chief and Electrician at the General Post Office, and A. J. STUBBS, Technical Officer, General Post Office, A.I.E.E. With upwards of 300 illustrations, mostly from original drawings. Appendix, Tables, and a full Index. 520 pages. Crown 8vo. **15s.**

"The most complete epitome of present-day telephonic practice."—*Electrical Engineer.*

THE PRACTICAL TELEPHONE HANDBOOK. By J. POOLE (Wh.Sc.), A.I.E.E., Chief Electrician to the New Telephone Company, Manchester. With 288 illustrations. Second Edition, Revised and considerably Enlarged. **8s.**

"This essentially practical book is published at an opportune moment."—*Electrician.*

ELECTRIC LIGHT INSTALLATIONS. By Sir D. SALOMONS, Vice-President of the Institution of Electrical Engineers, A.I.C.E., M.Amer.I.E.E., M.P.S. Seventh Edition, thoroughly Revised and Enlarged.

VOL. I.—ACCUMULATORS. With 33 illustrations. **5s.**

"The best work on the subject."—*English Mechanic.*

VOL. II.—APPARATUS. With 305 illustrations. **7s. 6d.**

VOL. III.—APPLICATION. With 32 illustrations. **5s.**

"A valuable addition to the literature of the subject."—*Engineer.*

PRACTICAL ELECTRIC LIGHT FITTING. A Treatise on the Wiring and Fitting up of Buildings deriving Current from Central Station Mains, and the Laying Down of Private Installations, including the Latest Edition of the Phœnix Fire Office Rules. By F. C. ALLSOP. With 224 illustrations. Second Edition, Revised. **5s.**

"The book is certainly very complete."—*Electrical Review.*

ELECTRIC LIGHTING FOR MARINE ENGINEERS; or, How to Light a Ship by Electric Light, and How to Keep the Apparatus in Order. By SYDNEY F. WALKER, M.I.E.E., M.I.M.E., Assoc.M.Inst.C.E. With 103 illustrations. Second Edition. Cloth, **5s.**

ELECTRICAL INFLUENCE MACHINES Containing a Full Account of their Historical Development, their Modern Forms, and their Practical Constructions. By J. GRAY, B.Sc. **4s. 6d.**

"This excellent book."—*Electrical Engineer.*

AUTO-CARS. By D. FARMAN, M.Inst..E.E., Sole Authorised Translation from the French by LUCIEN SERRIALLIER. With 112 illustrations. **5s.**

"This excellent book is full of every kind of information on motor cars."—*Electrical Review.*

"One of the most practical books yet written on the subject."—*Auto-Motor Journal.*

London: Whittaker & Co., White Hart St., Paternoster Square, E.C. 1790

DARLINGTON'S HANDBOOKS.

"Sir Henry Ponsonby is commanded by the Queen to thank Mr. Darlington for a copy of his Handbook."

"Prepared with considerable care."—*The Times.*

"Nothing better could be wished for."—*British Weekly.*

"Far superior to ordinary guides."—*London Daily Chronicle.*

1s. each. ILLUSTRATED. Maps by JOHN BARTHOLOMEW, F.R.G.S.

THE ISLE OF WIGHT.
THE VALE OF LLANGOLLEN.
BRECON AND ITS BEACONS.
BOURNEMOUTH AND THE NEW FOREST.
THE CHANNEL ISLANDS.
THE NORTH WALES COAST.
THE SEVERN VALLEY.
THE WYE VALLEY.
BRIGHTON, EASTBOURNE, HASTINGS, AND ST. LEONARDS.
ABERYSTWITH, TOWYN, BARMOUTH, AND DOLGELLY.
MALVERN, HEREFORD, WORCESTER, AND GLOUCESTER.
LLANDRINDOD WELLS AND THE SPAS OF MID-WALES.
BRISTOL, BATH, CHEPSTOW, AND WESTON-SUPER-MARE.

3s. 6d. net, 60 illustrations, 24 maps and plans,

LONDON AND ENVIRONS,

By E. C. COOK and E. T. COOK, M.A.

LLANGOLLEN: DARLINGTON & CO. LONDON: SIMPKIN, MARSHALL & CO., LD.

Railway Bookstalls and all Booksellers.

PHOTOGRAPHS, from negatives by RALPH DARLINGTON, F.R.G.S., of Scenery, Ruins, etc., in Italy, Greece, Asia Minor, and Egypt, 1s., 1s. 6d., 2s. 6d. Complete List, post free, **Darlington & Co., Llangollen.**

THE

ELECTRIC RAILWAY OF TO-DAY.

By H. B. PRINDLE.

Fully Illustrated. Post Free 2s. 6d.

CONTENTS:—The Electric Railway; The Power Station: The Electrical Apparatus; The Switchboard; Line Construction; The Motor; The Motor Truck; Overhead Construction; Curve Construction; Storage Batteries.

TO BE OBTAINED FROM

H. ALABASTER, GATEHOUSE & CO.,

4, LUDGATE HILL, LONDON.

TRADE

ROLL DROP

MARK.

EDISON
TRADE ROLL DROP MARK
THE FOREST CITY ELECTRIC CO.
CLEVELAND, O.

HYDRAULIC COLD FORGED

COMMUTATOR BARS

HAVE STOOD THE TEST OF TIME.

We have made 1,200 different styles, weighing from 1 oz. to 10 lbs. per bar, and there are millions of our bars in use, and our output is increasing daily. We require only a drawing of Bar or Commutator, and can fill orders within one week of receipt. No extra charge for dies.

THE FOREST CITY ELECTRIC CO.,

CLEVELAND, OHIO, U.S.A.

Cable Address:—"Rolldrop, Cleveland, U.S.A."

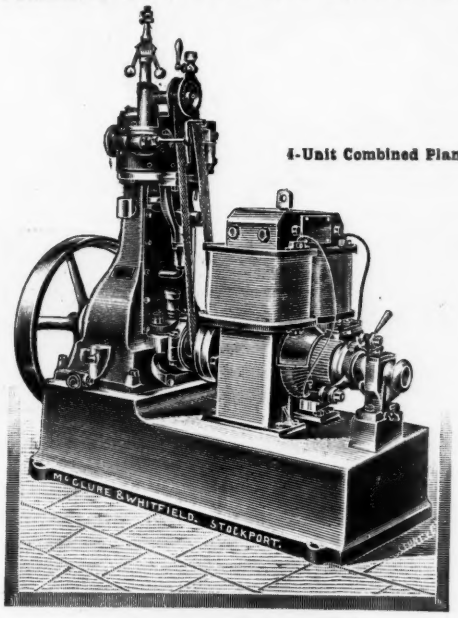
MERSEY DYNAMOS & MOTORS.

At any voltage from ½-H.P. upwards.

DYNAMOS

Fo Arc and Incandescent Lighting, Transmission of Power, Electroplating and Depositing, Electrolysis.

COMBINED PLANTS FOR SHIP LIGHTING &c.



4-Unit Combined Plant.

MOTORS

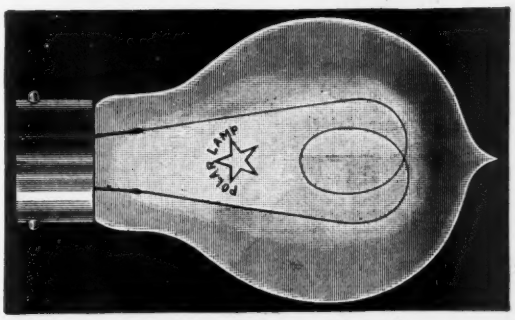
For Driving Cranes, Hoists, Pumps, Tools and all Classes of Machinery.

Prices and full particulars on application.

McCLURE & WHITFIELD,
STOCKPORT.
Telegrams:—McClure, Junr., Stockport.

THE

"POLAR" LAMP



High efficiency. Long life.
Moderate price.

CARBONS FOR ARC LIGHTS,

Dynamo Brushes, and Electrolysis.

AMBROIN,

The New Insulating Material.

SOLE AGENT:

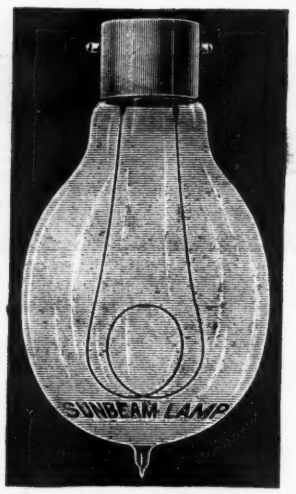
OSCAR SCHOLZIG, DASHWOOD HOUSE, LONDON. E.C.

THE SUNBEAM LAMP Co., Ltd.

GATESHEAD-ON-TYNE.

AGENTS IN EVERY PRINCIPAL TOWN.

Any Voltage. Any Candle-power. Any Efficiency.



English Made by English Workpeople of English Material.

Ordinary 16 C.P. 100 Volt.

MANUFACTURERS OF ALL KINDS OF ELECTRIC INCANDESCENT LAMPS.

Including Candle Flames, Tubular, Battery Lamps, &c., &c.

LONDON OFFICE: 50, FENCHURCH STREET, E.C.

"LUNDELL" MOTORS FOR ALL PURPOSES.

London—
17, SOHO SQUARE, W

Lundell Emery Grinder.

Lundell Ceiling Fan Motor.

Manchester—
EXAMINER BUILDINGS, STRUTT ST.

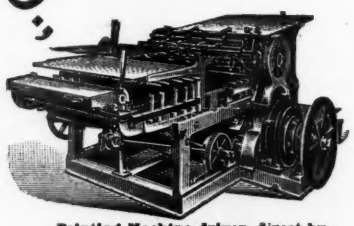
Lundell Desk Fan Motor.

J. H. HOLMES & CO.,

PATENTEES
and
MANUFACTURERS,

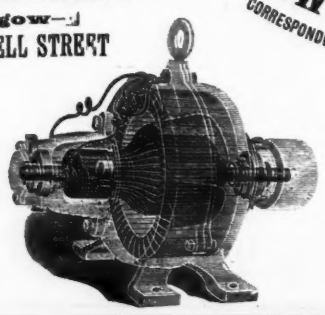
PORTLAND ROAD,
NEWCASTLE-ON-TYNE.
CORRESPONDENCE SOLICITED. ALL ESTIMATES AND ADVICE FREE.

Guillotine Paper Cutter, driven direct by 2-pole Lundell Motor.



Printing Machine driven direct by Lundell 6-pole Motor.

Glasgow—
27, BOTHWELL STREET



Small Lundell Power Motor.

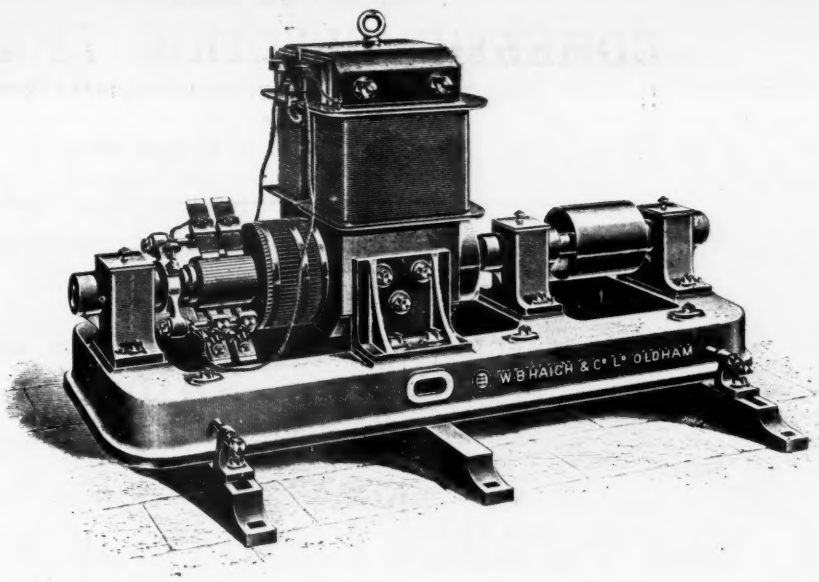
Yorkshire—
Mr. WILSON WOODHEAD
Royal Exchange,
LEEDS.

DYNAMOS AND MOTORS.

W. B. HAIGH & CO.,
LIMITED,
OLDHAM.

Send for]
CATALOGUE.

London Agents:—
D. H. BONNELLA & SON,
58 & 60, Mortimer St., W.
1194



STATION ENGINEERS KINDLY PERUSE.

FACSIMILE.

Telephone No 269

Arthur Ellis MIEE
Borough Electrical Engineer

Corporation Electricity Works.
Spa Road. Bolton
August 16th 1897.

Messrs Meldrum Bros.
Atlantic Works.
City Road.
M'Chester

Dear Sirs, In reply to your circular letter of the 12th inst. I beg to inform you that we have your system of forced draught fitted to all our Boilers, 5 in number. We have had them since the works were opened in 1894 & are exceedingly well pleased with the results. We are able to burn "Coke breeze" at 1/6 per ton instead of 4/- for all that we use the record any close for coal. I feel sure your must say about 40% per unit. We are also having them fitted to our new Boilers.

Yours faithfully
Arthur Ellis

MORE STEAM.

LESS COST.

Over
5,000
at work.

We are prepared to fix under guarantee, and, if we fail, to remove free of cost.

MELDRUM BROS.,

Atlantic Works, MANCHESTER, also at
LONDON, PARIS, NEW YORK, &c. 1402

PRICE ONE SHILLING.

DOMESTIC ELECTRIC LIGHTING,

TREATED FROM THE CONSUMERS' POINT OF VIEW.

BY

ED. C. DE SEGUNDO, ASSOC.M.INST.C.E.

POST FREE, 2s. 6d. WITH 34 ILLUSTRATIONS

OZONE:

ITS COMMERCIAL PRODUCTION AND ITS APPLICATIONS.

By EMILE ANDREOLI.

POPULARLY WRITTEN AND FULLY ILLUSTRATED. POST FREE, 1s.

THE STRANGE HISTORY OF A DYNAMO.

By T. E. GATEHOUSE.

Should be read by all interested in the production of electricity. An excellent gift for schoolboys.

ILLUSTRATED. 3s. 6d. POST FREE.

POLYPHASED ALTERNATING CURRENTS,

By E. HOSPITALIER.

CONTENTS:—Introduction. I. Triphased Currents. Chapter 1. Generation. Chapter 2. Transformation. Chapter 3. Applications, Electric Lighting, Motors. Chapter 4. Multiple Transformers.

II. Diphased Currents. Chapter 1. Generators. Chapter 2. Transformers. Chapter 3. Motors. Chapter 4. Multiple Transformers. Appendix A. Appendix B.

---

89 Illustrations. Post Free, 2s. 6d.

PHOTOGRAPHIC & OPTICAL ELECTRIC LAMPS.

By RANKIN KENNEDY.

A Treatise for Photographers, Photo-Electric Printers' Etchers and Engravers, and including Apparatus for Copying Purposes for Engineers and Architects.

THE ONLY WORK IN EXISTENCE TREATING ON THIS SPECIAL SUBJECT.

HOW TO MAKE AND USE THE STORAGE BATTERY:

Embracing its History, Theory, Maintenance, and the Installation of Plants.

BY P. B. WARWICK.

ILLUSTRATED. POST FREE, 6s.

CONTENTS:—The Discovery of the Secondary Cell; Chemistry of Lead-Lead couples; Basic Patents; How to Make a Practical Storage Battery; Some Modern Types of Storage Batteries; Lead, Zinc, Copper, Alkaline and other Storage Batteri How to Instal, Work and Maintain a Storage Battery Plant; Index

---

Any of the above Books can be had, Carriage Paid, by sending a remittance for the price indicated to—

H. ALABASTER, GATEHOUSE & CO., 4, Ludgate Hill, London.

J. P. HALL & CO., OLDHAM,

MAKERS OF

DYNAMOS & MOTORS

TELEGRAMS: DYNAMO, OLDHAM
TELEPHONE No. 300

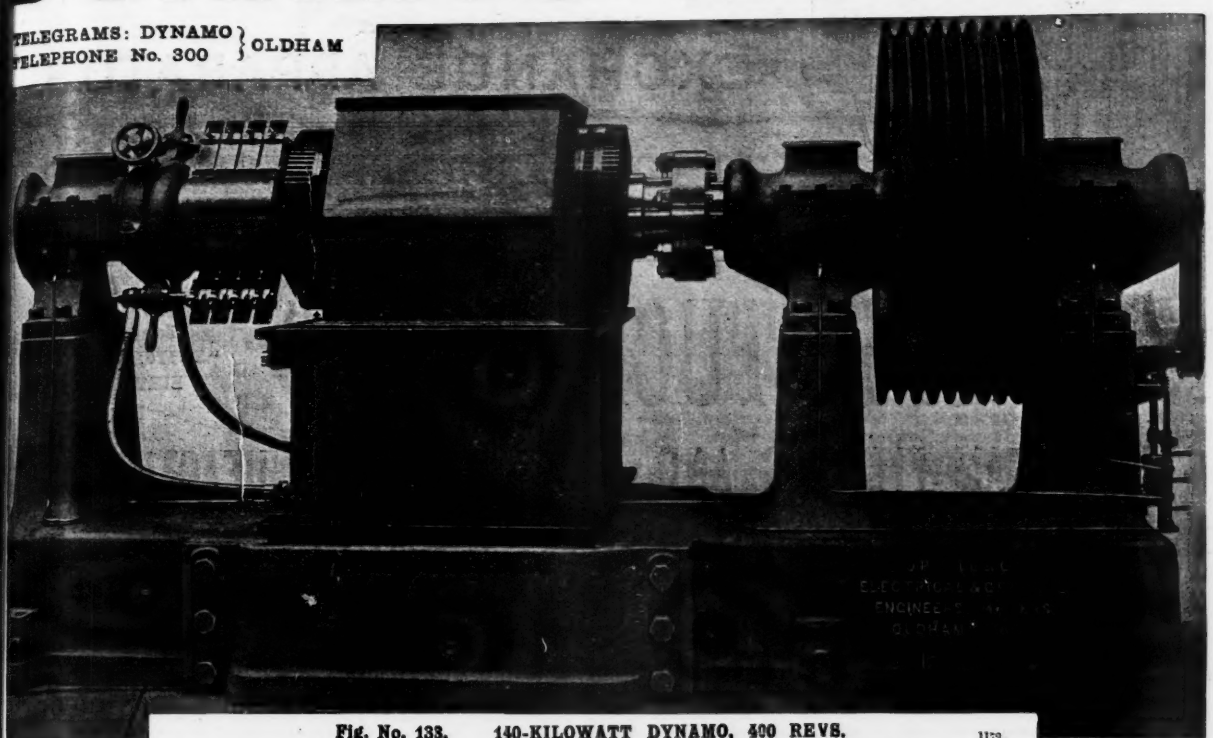


Fig. No. 133. 140-KILOWATT DYNAMO, 400 REVS. 1172

BAXTERS & MACDONALD

OFFICE ADDRESS:—
31, Murraygate, Dundee.
WORKS:—
Commercial Court.

MICA

MINE OWNERS AND MANUFACTURERS OF MICA FOR ALL PURPOSES.

Large Stocks at our Stores in Dundee, of Ruby, Clear and Clouded. Regular shipments received direct from the mines.

Contractors to Her Majesty's Government. a113

MICA

For Dynamos, and all Electrical Purposes. Large stocks of all qualities on hand. Speciality, Mica for Commutators, cut to any shape, and of equal and uniform thickness.

SANDERS, WAKE & CO.,

Office—23 Great St. Helens, LONDON, E.C.,
Contractors to H.M. Government.

Telegrams—"Awake, London." *Telephone*—2,288, Avenue. a288

TRADE MARK

SPECIALISTS IN

VENTILATING

By Electrical or any other Motive Power.

BLACKMAN VENTILATING CO., LIMITED,

68, Fore St., London, E.C., and branches. 9136

PRICES CONSIDERABLY REDUCED. **PRICES CONSIDERABLY REDUCED.**

BUSS-SOMBART'S

TACHOMETERS & TACHOGRAPHS

PORTABLE AND STATIONARY TYPES.

Over 5,000 in use.

UNEQUALLED FOR PERMANENT ACCURACY AND WORKMANSHIP.

Used and constantly ordered by the principal Dynamo Makers all over the World. 47

SOLE MAKERS:

AKTIEN-GESELLSCHAFT STRUBE, Magdeburg.

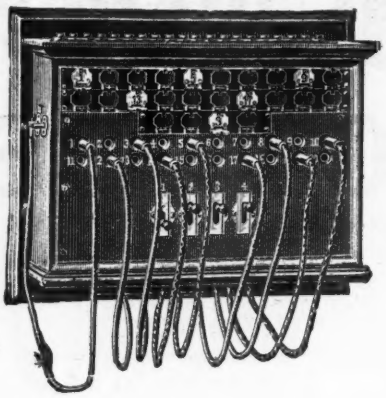
Established 1837. Telegraphic Address: "Unsworth, Derby.

G. B. UNSWORTH. GREEN LANE MILLS DERBY.

Manufacturer of Electrical Wires of every description for Electrical Instruments, Dynamo Machines, Telephones, and Electric Bells.

INSULATED LINE WIRES AND CABLES.

London Agents:—JOHN DAVIS & SON, 118, Newgate Street, E.C. 1144



WESTERN ELECTRIC CO.,

MANUFACTURERS OF

TELEPHONE

and

EXCHANGE APPARATUS.

79, COLEMAN STREET, LONDON, E.C.

CHICAGO, NEW YORK, ANTWERP, PARIS, & BERLIN. 1190

London Office: 2, HOLBORN PLACE, HIGH HOLBORN.

J. H. TUCKER & CO.,

Telegrams: "SWITCHES, BIRMINGHAM."

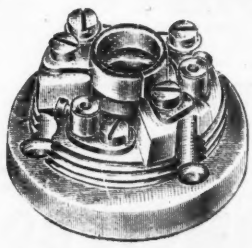
ELECTRICAL FITTINGS AND ACCESSORIES MANUFACTURERS,

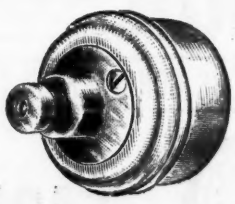
16, OOZELLS STREET, BIRMINGHAM.

CONCENTRIC

WALL SOCKETS.

HIGH INSULATION. LARGE CONTACT SURFACES.





The Brush Uncased.

THE "SPARKLESS GEM"

DYNAMO AND MOTOR BRUSH.

(Chaplin's Patents.)

As Supplied to the Leading Municipal Electric Light Stations throughout the United Kingdom.

MADE OF No. 36 B.W.G. HIGH CONDUCTIVITY COPPER WIRE.

The peculiar construction of this Brush ensures perfect contact with the Commutator, even when much worn; and renders it so superior in all points to the older types of brushes that it is rapidly displacing them for Dynamo and Motor work of every kind. The result is brought about by the spongy nature of the contact surface. With the lightest possible pressure the highest conduction is attained, sparking is prevented, wear on the commutator is reduced, and its temperature lowered.

The cost is no more than that of the common gauze brush. To be had from

THE ELECTRICAL ENGINEERING STORES,

MINORIES. BIRMINGHAM,

OR OF

Bertram Thomas, Cornbrook Telegraph Works, Manchester;
Beanland, Perkin & Co., Prudential Buildings, Park Row, Leeds;
Wm. McGeoch & Co., 108, Argyle Street, Glasgow; and other dealers. 1000

The Brush Complete.

Swansea.—The Mayor has a scheme to lay before the Council for lighting the new market by electricity.

Torquay.—Mr. Medway, late of H.M.S. *Defiance*, has been appointed engine driver and assistant engineer at the Corporation Electricity Works.

Westminster.—The General Purposes Committee of St. James's (Westminster) Vestry has recommended that the Vestry Hall be lighted by electricity at an estimated cost of £60 (including prime cost of £44 for electroliers), and that it be referred to them to obtain estimates and designs for carrying out the work.

Willesden.—The District Council has made a slight alteration in its committees. In place of the Wharf and Sub-electric Lighting Committee it has appointed an Electric Lighting and Wharf Committee, and has referred to it consideration of various questions, the two first being electric lighting and dust destructors. The names of the committee are Messrs. Ginger, Reed, Adams, Cowley, Godson, Knight, Luke Morley, Penny, Pinkham, Priest, Pryor, Richards, Smith, and Stewart.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Belfast.—"Civil Engineer" writes a lengthy letter to the *Northern Whig* in which he goes into the question of the advisability of the municipality purchasing the tramways, working them by electrical power, and carrying out various extensions.

Bournemouth.—The Roads' Committee have gone into the proposed electric light railway and tramway schemes which had been brought before the Council, and recommended that any such scheme should be in the hands of the Council, and that the Council should oppose other proposals. The Council will discuss the whole matter in committee.

Bristol.—The Light Railway Commissioners have announced their decision to grant the Bristol Tramways Company's application for an order to extend their electrical system from St. George to Hanham, and have thus thrown aside the contention of the Bristol Town Council that the line should be placed under the Tramways Act of 1870, so as to give the local authorities the power of purchase conferred by that measure. The Commissioners have ordered that the purchase, if carried out, shall be as a going concern, though they did not in their intimation of their decision state the earliest date at which the local authorities might buy on those terms. At the inquiry, where the subject was referred to, the managing director of the company, Mr. George White, did not object to a reasonable purchase clause on the principle that the undertaking should be valued as a going concern, and the chairman, the Earl of Jersey, called attention to an order in the Potteries District fixing 35 years as the term; there had been however cases in which 40 and even 50 years had been fixed. The decision was received with rejoicings in Hanham and St. George.

Buenos Ayres.—The City Council has now under consideration an application from Messrs. Lezica and Gonzales Segura, for the construction of an underground electric tramway. This is not the only petition of this class awaiting consideration, and there is the Bright petition before the National Congress. If all the over and underground electric trams are constructed for which concessions are asked, Buenos Ayres will be the best equipped city in the world for means of locomotion; but unfortunately, says the *Review of the River Plate*, not one-half, nor yet one-third of the lines will ever be commenced.

Edinburgh Cable Cars.—From 6 o'clock to 9 o'clock the other evening the cable cars on the Hanover Street and Golden Acre route were at a standstill in consequence of a mishap resulting from a driver's inadvertence.

Electric Motor Dustcarts.—A short time ago the Vestry of Kensington instructed the Plant and Wharves Committee to report upon the employment of motor carts for the collection of house refuse. In this connection the Committee, at the Vestry meeting held on Wednesday evening, submitted the following report from the Vestry Surveyor: "I have considered the question of motor vans for the parish work, and am of opinion that steam or oil motors are unsuitable for the work of the Vestry, but that the adoption of electrically propelled vans, as suggested in my report of 12th March, 1892, is highly desirable. The only question is whether the time is ripe for their adoption. Upon this point, after carefully considering the subject, and all the details connected therewith, and after consulting the best authorities in the Metropolis, I am of opinion that the subject should be deferred for the present. I may add that as I was the first Municipal Surveyor to suggest the employment of electric traction for the haulage of dust carts, I will take care that this Vestry shall not be behindhand in the prudent adoption of such motors, but at the present time I am of opinion that it is not advisable to go in for same." In presenting this report the Plant and Wharves Committee expressed their concurrence in the opinion therein stated.

Gateshead.—A meeting of the shareholders of the Gateshead and District Tramways Company is to be called to consider the following matter:—The directors, in a circular addressed to the shareholders, state "that negotiations have been proceeding for some time past, between the directors of this company and the directors of the British Electric Traction Company, Limited, with a view to the adoption by this company of electric traction, and an agreement has been entered into (subject to the approval of the shareholders of this company) between the respective companies, by which, subject to arrangement being made with the proper authorities, the British Electric Traction Company will purchase the existing shares in this company at the price of £4 15s. each; but unless the British Company is able to so purchase three-fourths of such shares within a specified time, this company is to sell to the British Company the whole of its undertaking for such a sum as (after discharging liabilities) will leave the shareholders £4 15s. per share. The shareholders of this company will have the option to receive this amount in 6 per cent. preference shares at par either in this company or some other company which may be formed to acquire its undertaking."

Great Orme's Head.—A syndicate has been formed to promote the construction of an electric railway to the highest level of the Great Orme, and last week Mr. Enfield Taylor, engineer, Chester, attended a special meeting of the Llandudno District Council to submit plans of the proposed scheme. It is suggested that the line start from the site now occupied by the old Victoria Hotel, in Church Walks, and proceed along the road to St. Tudno Church, crossing some fields to the right of the church to a terminus not far from the old telegraph station and the Great Orme lighthouse. The Council approved the scheme with only one dissentient.

Hartlepool.—We learn from the daily press that one of the overhead electric tramway wires broke the other evening. A horse was killed, and several people who endeavoured to disentangle the animal from the wire received severe shocks.

It is also stated that a Mrs Otley has just died from injuries she sustained when two of the electric cars collided on November 13th. The driver lost control of the car owing to the brake failing to act, and the result was it ran into a car coming in the opposite direction.

Leith.—The Town Council recently offered the Edinburgh Street Tramways Company £66,000 for the tramways (the company previously asked £75,000), but the company refuses to consider the offer, and the negotiations have come to an end.

South Staffordshire Power Scheme.—As is now well-known, the Midland Electric Corporation for Power Distribution, Limited, has served notice of its intention to apply to the Board of Trade for a provisional order, to be confirmed in the next session of Parliament to supply electric power in South Staffordshire. Mr. Arthur L. Lorne, the secretary of the company, has issued a circular in which he states that the primary object of the company is the supply of electric energy to manufacturers throughout the South Staffordshire district. In addition, the company will be prepared to let to customers motors on hire, and to look after and maintain them, so that consumers can avail themselves of the advantages of power supply practically without capital expenditure on their own account. It is anticipated that this will be a great advantage both to manufacturers at present in the district, and to others who may desire to avail themselves of such an electric supply, but who would hesitate to make the necessary capital outlay themselves. It is also anticipated that when once such facilities are available it will lead to new industries settling in the district, and will thus increase its prosperity and rateable value. Further, as suppliers of electric energy, the company will be prepared to undertake electric lighting. By grouping together the various populous centres in the South Staffordshire District, and by serving them from one central station, under one management, the current can be produced more economically than if each individual Local Authority undertook its own supply. The power being taken during the day on a large scale from the central station, the costs for lighting will be lowered.

St. Helens.—The Corporation recently appointed the Electrical Traction Committee, and has now received a report from Dr. Hopkinson. The committee has resolved, in accordance with the recommendations of this report, to adopt the Boundary Road depôt as the site for the generating station, the necessary steam to be supplied by the refuse destructors to be erected at the same place. Dr. Hopkinson has been instructed to prepare a specification for the erection of the station, and for the system of overhead conductors. In connection with the above proposals the Health Committee have invited tenders for destructors to be erected at Boundary Road.

Swansea.—The *Western Mail* says that Mr. Frank Dawe is the electrical engineer appointed by the Swansea Tramway Company to carry out the work of electrically equipping the line, and it is understood that the first consignment of rails for re-laying the line is on the way to Swansea by steamer.

TELEGRAPH AND TELEPHONE NOTES.

Cables to the Cape.—We hear of the repair of the St. Thomé-Loanda cable, which forms one of the sections of the telegraph route to the Cape, along the West Coast of Africa, and which was interrupted on the 8th ult. This repair was, we believe, effected on November 29th, and thus for three weeks traffic to the Cape has been dependent on the line along the East Coast of Africa, on which route it appears that during the three weeks in question no interruptions have occurred. We understand from various communications which have been sent to the press, and which, although differing from each other in detail, point to one general conclusion, that it is proposed to establish a system of cables *vid* St. Helena

and Ascension, which will triplicate the present means of telegraphing to South Africa, which, owing to the periodic recurrence of interruptions, cannot be regarded with any degree of confidence. It is further proposed, we believe, to continue the line from the Cape to Australia. For such an extension Kerguelen Island might form a convenient midway station; but as no regular traffic can be expected from this source it could only be useful as a transmitting station. However, doubtless those who are interested in the matter have given it their best attention.

Postal Telegraphists.—A deputation of Aberdeen telegraphists waited on Mr. Bryce, M.P., the other day, with reference to telegraphists' grievances, and especially with a view to enlisting Mr. Bryce's support for the motion to be proposed by Mr. Sam Woods, M.P. In reply to the deputation, Mr. Bryce said that he found himself unable to go so far as some of the speakers in thinking that the right of Government servants as regarded combination to strike ought to be exactly the same as that of other workmen. That was a very large demand to make, because, in the first place, the Government servants had a permanency, which other workmen had not. In the second place, there were pensions in many Government Departments. Other employés of private employers had none. The business of telegraphy was of the utmost importance to the country. Any sudden or universal strike of all the telegraphists would be such a calamity that it could not be looked upon in the light of a strike, in the same way as that of the engineers. As to the Newcastle incident, he held that telegraphists were wrong in passing a resolution which suggested a general strike, and he was not surprised that the Department reprimanded them. Mr. Bryce defended Lord Tweedmouth's Commission from the charge of partiality.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	April 6th, 1893 ...	...
West Indies—		
St. Croix-Trinidad ...	Nov. 30th, 1896 ...	...
Paramaribo-Cayenne ...	Oct. 25th, 1897 ...	...
Amazon Company's cable—		
Parintins-Itacatiara ...	May 5th, 1896 ...	...
Obidos-Parintins ...	Dec. 7th, 1896 ...	...
Otranto-Vallona	Oct. 11th, 1897 ...	...
San-Thomé-Loanda	Nov. 8th, 1897 ...	Nov. 29th, 1897.
Pernambuco-Ceara	Nov. 24th, 1897 ...	...
Vigo-Borkum	Nov. 28th, 1897 ...	...
Landlines.		
Trans-Continental line beyond Masol	March 12th, 1896 ...	...
Carthagena - Barranquilla (Columbia)	July 4th, 1896 ...	...

Telephony in Lambeth.—The Lambeth Vestry a month ago conditionally granted the application of the National Telephone Company to lay underground tubes in the parish. In this connection the General Purposes Committee, at a meeting of the Vestry last week, submitted a reply received from Mr. C. B. Clay, the metropolitan surveyor to the company, in reference to a letter forwarded by the Vestry on the matter. In the course of his communication Mr. Clay said: "The object of the company in making this application is to improve the system. The company erected its plant on the single wire principle, which at the time was believed to be best. When it was later on found that the metallic circuit system was preferable, the company spent over £300,000 in converting its plant; and now they are willing, in order to further improve the service, to place these wires underground, provided the necessary facilities are given them by the Vestries, notwithstanding the fact that the £300,000 recently spent will be practically thrown away. I believe it is the desire of the Vestries that wires, and especially cables, should, as far as possible, be placed underground." The Vestry decided that Mr. Clay should be asked to meet the General Purposes Committee to discuss the matter.

Telegraph Interruptions.—In a letter to the *Times* on the "delays in the cable service to Australia," Mr. H. P. Daly also refers to another instance where serious results would assuredly occur in the event of an interruption. Attention was drawn to it some time ago by Sir Albert Rollit. "If the aerial lines across India from Bombay to Madras (more than 1,000 miles) were from any cause to be severed, the only way in which a telegram could reach China, the Straits Settlements, Australia, Tasmania, and New Zealand would be by means of the land line wires across Russia and Siberia."

The Deutsche See-Telegraphen Gesellschaft.—We understand that the ss. *Seine* was lying off Dover on Saturday (27th ult.) morning, on her way to repair the Emden-Vigo cable of the above-named company. This is smart work, as the Berne announcement that this cable was interrupted is dated the 28th. The cable was opened for traffic on January 1st of this year, was interrupted from February 10th to February 14th, again broke down on March 24th, and was, presumably, repaired, as we find another notice of its interruption on July 4th, and repair on the 5th. Now we learn that in the course of its chequered career it has again become useless. It would be interesting to know to what cause the interruptions are due, as the frequency of these troubles is exceptional.

The Eastern Extension, Australasia and China Telegraph Company.—This company has announced that its cable system from Manila having been extended to the Islands of Panay (Ilioilo), Negros, and Zebu, telegrams can now be accepted for direct transmission to these places.

Underground Telephone Wires.—The Commissioners of Sewers of the City of London have issued a printed summary of their minutes and correspondence in regard to underground telephone wires, and, according to the *Times*, request attention more particularly to one portion which relates to the action of the Post Office authorities in providing wires for the use of the National Telephone Company without having first obtained the consent of the Commissioners, as the local authority, to the opening of the public ways for that specific purpose. It is pointed out that an easement under the streets is thus given by a public Department to a trading company without the consent of the local authority, who are thereby deprived of the opportunity of imposing any conditions for the protection or advantage of the public—a practice that has never received the sanction of Parliament.

On Wednesday, the action brought by the Postmaster-General against the Commissioners of Sewers for the determination of a difference which had arisen between them under the joint operation of the several Telegraph Acts, came before Mr. Commissioner Kerr, who decided the difference unfavourably to the Commissioners.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barrow-in-Furness.—December 15th. The Corporation wants tenders for the supply and erection of boilers, pumps, economiser, &c., engines, generators, switchboards, accumulators, high and low tension cables, conduits, &c. See our "Official Notices" last week for full particulars. Consulting engineers, Messrs. Kincaid, Waller & Manville.

Canterbury.—December 20th. The Corporation Electric Lighting Committee is inviting tenders for the supply of Lancashire boilers, and boiler house plant, steam dynamos, condensers, &c., for the engine house, overhead travelling crane, switchboard, accumulators, mains, arc and incandescent lamps, meters, &c. Consulting engineer, Mr. Robert Hammond. See our "Official Notices," November 19th.

Dundee.—December 3rd. The Gas Commissioners want tenders for an economiser for the electricity works. Electrical engineer, Mr. W. H. Tittensor. See our "Official Notices," November 19th.

France.—December 14th. Tenders are being invited by the French Posts and Telegraph Authorities in Paris, for the establishment of two pneumatic pipe lines between the Post Offices in the Rue Monge and in the Rue Saints-Peres. Tenders to the Sous-Secretariat d'Etat des Postes et des Telegraphes, 103, Rue de Grenelle, Paris.

Italy.—December 30th. Tenders are being invited by the Municipal Authorities of Catanzara, for the construction of a tramway between the centre of the town and the railway station, to be operated either by electricity, steam or cable.

Leicester.—January 31st. The Leicester Corporation invites designs and tender for motor vehicles for the collection of house refuse. Specifications and particulars, with drawings, to be sent to the Chairman of the Sanitary Committee, to the office of Mr. E. Geo. Mawbey, C.E., borough engineer, Town Hall, Leicester.

Londonderry.—December 9th. The Corporation want tenders for the supply of carbons for one year. Electrical engineer, Mr. J. Christie. See our "Official Notices," November 19th.

Newport.—December 15th. The Corporation wanted tenders for electric lighting plant for temporary lighting at Wentwood Waterworks (350 16-C.P. lamps). See our "Official Notices" for this week.

Singapore.—December 31st. The Municipal Commissioners are inviting tenders for the lighting of street lamps for a period of five years. Particulars from Mr. C. C. Lindsay, 167, St. Vincent Street, Glasgow, or the secretary to the Municipal Council.

Spain.—December 16th. The Municipal Authorities of Villarramiel (Palencia province) are inviting tenders until December 16th for the concession for the electric lighting of the town during a period of 20 years. Tenders to be sent to El Secretario del Ayuntamiento de Villarramiel (Palencia).

Spain.—December 21st. The municipal authorities of Reus (Tarragona Province) are inviting tenders for the concession for the electric lighting of the town. Tenders to be sent to El Secretario, del Ayuntamienti de Reus (Tarragona).

St. Pancras.—December 28th. The Vestry wants tenders for the supply and erection of "arc lamp posts and circuits complete," also feeding and distributing mains. Particulars from the chief clerk to the electricity department. See our "Official Notices" this week.

Warrington.—December 3rd. The Cheshire Lines Committee are inviting tenders for the supply of stores and materials for the year 1898. There are nineteen items, No. 6 being for telegraph materials, instruments, wire, &c. Particulars from Mr. S. Saxton Barton, storekeeper, Cheshire Lines, Warrington.

Worthing.—The Electric Light Committee want offers from persons willing to instal and maintain the electric light in the borough. See our "Official Notices."

CLOSED.

Roumania.—The Société L'Eclairage Electrique, of Paris, has secured a contract from the Roumanian State Railway Authorities for the electric lighting of the railway stations at Jassy Sinaia, Ploesti and Craiova.

Southampton.—Under "Electric Lighting Notes" will be found a note of the contracts given to Messrs. Crompton & Co., Ltd., and the Chloride Electrical Storage Syndicate by the Council.

FORTHCOMING EVENTS.

1897.

Friday, December 3rd.—Institute of Marine Engineers. Annual conversazione at the Town Hall, Stratford.

Saturday, December 4th.—Salford Science Students' Association. Annual general meeting and soirée.

Monday, December 6th.—North East Coast Institution of Engineers and Shipbuilders, Sunderland. Paper by C. H. Innes on "The Theory of the Centrifugal Pump and Fan."

Royal Institution. General monthly meeting at 5 p.m.

Society of Arts, at 8 o'clock. Second of a series of three lectures on "Gutta Percha," by Dr. Eugene F. A. Obach. Synopsis of Lecture II: *The Cleaning Processes.*—Mechanical cleaning process—Loss during mechanical cleaning—Chemical washing process—Chemical hardening process—Extraction from raw material and from leaves by means of solvents—Advantages and disadvantages of the different processes—Natural substitutes for gutta percha.

Tuesday, December 7th.—Röntgen Society. First ordinary general meeting, at 8.30 p.m., at the Medical Society's rooms, 11, Chandos Street, W., Prof. J. H. Gladstone presiding. Paper by Mr. A. A. Campbell Swinton on "Adjustable X-Ray Tubes."

Wednesday, December 8th.—Society of Arts. "The Mining and Metallurgical Industries of Sweden as shown at the Stockholm Exhibition of 1897," by Bennett H. Brough.

Institution of Electrical Engineers.—Students' meeting at 7.30 p.m. Mr. B. H. Adler will read a paper on "Asbestos and the Use of Asbestos in Electrical Engineering."

Thursday, December 9th.—At the Free Church College, Aberdeen, Prof. J. A. Ewing, M.A., B.Sc., F.R.S., commences at 3 o'clock a series of ten "Thomson" lectures on "Magnetism." The lectures will be concluded on December 22nd.

Institution of Electrical Engineers, at 8 o'clock. Annual general meeting for members and associates only.

Last day for receipt of Londonderry carbon tenders.

Friday, December 10th, 8 p.m.—The Institution of Junior Engineers, at Westminster Palace Hotel. Paper on "Main Engine Auxiliaries in the Mercantile Marine," by Mr. Basil H. Joy, Vice-Chairman.

Physical Society meeting.

Saturday, December 11th, at 7 p.m.—North East Coast Institution of Engineers and Shipbuilders, Newcastle-on-Tyne. Paper on "Some Methods of Filtering and Heating Feed Water," by Mr. A. H. Burbidge. Synopsis:—Introduction—Advantages of a Feed Water Filter and Heater—Types of Feed Water Filters and Heaters—Economisers—Conclusion.

Monday, December 13th.—Yorkshire College Engineering Society. "The Daimler Motor and its Application to Auto-cars" (*illustrated*), by J. S. Critchley (Daimler Motor Company, Limited).

Wednesday, December 15th.—Society of Arts. "The Purification of Sewage by Bacteria," by Samuel Rideal, D.Sc.

Tuesday, December 21st.—Brazilian Submarine Telegraph Company. Interim dividend payable.

Tuesday, December 28th.—The Royal Institution. The first of a series of six Christmas lectures (juvenile) on "The Principles of the Electric Telegraph," by Dr. Lodge, F.R.S.

NOTES.

Appointment Vacant.—The Sheffield Tramways Committee want a resident electrical engineer in connection with the conversion of certain of the existing tramways into the electric overhead system and the construction of extensions of tramways on the same system. See our "Official Notices" for particulars.

Gilbert's Luxury.—It is a novel occurrence for us to notice a pipe, unless it be a steam, water, gas, or underground cable pipe, but as the majority of engineers smoke, we would draw their attention to the device illustrated in our advertisement pages. The principle appears good, as also the combination cigar and cigarette holders (judging from the drawing), and we would suggest a trial of Gilbert's luxury. Mr. Gilbert, an old member of the electrical fraternity, tells us he is a great smoker, and that his new pipe is the result of 20 years' deep thought, which goes to show that the art of inventing is not easily acquired. For those who have a sensitive palate, they could not, in our opinion, do better than try the pipe, which, we are told, is used by some leading electrical men.

Royal Society.—The anniversary dinner of the Royal Society was held on Tuesday evening, in the Whitehall rooms of the Hôtel Métropole. Lord Lister presided, and a very distinguished company was present. At the annual meeting which preceded the dinner, Lord Lister referred to the various matters of interest to the society which had transpired since the last meeting. The medals were afterwards presented, among them being a Royal Medal to Prof. A. R. Forsyth for his contributions to the progress of pure mathematics, and especially for his work on differential equations and the theory of functions; and a Davy Medal to Dr. J. H. Gladstone for his numerous contributions to chemical science, and especially for his important work in the application of optical methods to chemistry. The following is a list of the officers and council who were elected for the ensuing year:—President—Lord Lister; treasurer—Sir John Evans; secretaries—Prof. Michael Foster, Prof. Arthur William Rücker; foreign secretary—Sir Edward Frankland; other members of the council—Prof. William Grylls Adams, Prof. Thomas Clifford Allbutt, Sir Robert Stawell Ball, Rev. Thomas George Bonney, Prof. John Cleland, Prof. Robert Bellamy Clifton, Prof. James Alfred Ewing, Alfred Bray Kempe, John Newport Langley, Joseph Larmor, Prof. Nevil Story Maskelyne, Prof. Raphael Meldola, Prof. Edward Bagnall Poulton, William James Russell, Dukinfield Henry Scott, Prof. Walter Frank Raphael Weldon.

American Society of Mechanical Engineers.—The New York Convention of this Society was opened on Tuesday last, November 30th, at 9 p.m., by the Presidential Address by Mr. W. R. Warner, whose theme was the "Evolution of the Telescope." Papers were to be read on Wednesday, Thursday, and to-day, as follows:—

Christie, W. W.: "Boiler Tests: Classification of Data and Plotted Results." Dean, F. W.: "Reduction of Cost of Steam Power from 1870 to 1897." Carpenter, R. C.: "Test of Centrifugal Pump and Calibration of Weir at the Bridgeport Pumping Station, Chicago." Stillman, Howard: "A Water Purifying Plant." Thurston, R. H.: "Multiple Cylinder Engines: Effects of Variation of Proportions and Variable Loads." Aldrich, W. S.: "Notes on Rating Electric Power Plants on the Heat-unit Standard." Keep, Wm. S.: "Cast-Iron under Impact." Mayo, Jno. B.: "A Strength of Gear Chart." Guelbaum, David: "A Law of Hydraulic Obstruction of Flow in Pipes." Richmond, George: "Thermo-Dynamics without the Calculus." Norris, H. M.: "An Accurate Cost-keeping System." Main, Chas. T.: "The Valuation of Textile Manufacturing Property." Smith-Whaley, W. B.: "Electricity in Cotton Mills." Hartness, Jas.: "Screw-Die for the Turret Lathe." Hartness, Jas.: "Stay-Bolt Threading Device." Rice, A. L.: "Convenient Form of Wire Testing Machine." Woodbury, C. J. H.: "Dustless Buildings." Fletcher, Andrew: "The Stevens Valve Gear for Marine Engines." Dickie, Geo. W.: "Auxiliary Engines and Transmission of Power on Naval Vessels." Bissel, Geo. W.: "A Boiler Setting." Mumford, E. H.: "Machine Moulding without Stripping Plates."

Various visits had been paid to works, and other places of interest, and there were also conversaziones, luncheons, &c., usual on such occasions.

The "Indian Engineer" Diary, 1898.—We have received, as usual, a copy of the *Indian and Eastern Engineer* Diary for next year. It is a book which cannot fail to be of considerable service in engineering and commercial offices, particularly those houses which do business with India and the Eastern countries. There is some useful data on engineering matters, and the railways, shipping, and general topographical information regarding India are briefly detailed.

Lord Reay on Technical Education.—Lord Reay presided at the annual meeting of the Scottish Association for the promotion of Technical and Secondary Education, which was held in Edinburgh on Saturday last, and delivered an address on the urgent necessity of paying more attention in this country to organising and systematising technical education. While the Victorian Era had been rich in men of the highest scientific eminence, other nations not possessing men of equal eminence had enriched themselves by the teaching of the men who filled such glorious pages in our history. In chemistry, in physics, in electricity, in geology, in astronomy, the most illustrious names of Scotsmen and Englishmen could be mentioned; but when it came to the adaptation of their teaching in the school, in the workshop, on large landed estates, they had to go to Germany, to the United States, to Switzerland, and to Belgium. The reason was, as Prof. Mahaffy had recently declared, that the "social estimate" which we had adopted of the higher education had forced our young merchants, young manufacturers, and young landowners into the channels, not of a *bonâ fide* arts course, but of a sham classical education. Our system of education ought to be worked on entirely different lines. No spasmodic efforts here and there to form science classes, but technical schools which led to technical colleges, on a carefully graded system, were needed. While the greatest activity prevailed in the technical schools and engineering works of the Continent and of America, we were engaged in the most calamitous and suicidal industrial war of modern days. We certainly had the brains and the capital, and what we wanted was organisation. The Education Department would have to determine clearly the lines of demarcation of the various forms of education which it would support. In the United States, Germany, France, and Switzerland, public money was ungrudgingly given to technical schools, and there was no reason why in this country there should be so much hesitation. The cause of the success and progress of Continental industry was due to the keen sense of competition, and to the widespread conviction that all production must be placed on a scientific basis. Science there was not considered as a luxury, but as a powerful agent of economic production. The sooner we realised that our very existence as an industrial nation was threatened the better.

The Institution of Junior Engineers.—On Saturday afternoon, November 20th, a large number of the members availed themselves of the opportunity for visiting the Electricity Works of the Islington Vestry at Eden Grove, Holloway. They were shown over by Mr. Albert Gay and Mr. C. H. Yeaman. The station was opened in March of last year. Since the station was opened it has been necessary, to meet increasing demands for current, to increase the plant by the addition of four Lancashire boilers, two slow-speed horizontal engines, each of 500 I.H.P., direct-coupled to alternators, each of 300 kilowatts.

Motor Car Competition.—Yet another motor car competition, or perhaps we should say "another *announcement*" of a competition. This time the trials will be conducted under the auspices of the Self-propelled Traffic Association, the Liverpool and District centre of that body having just issued particulars of a competition for motor vehicles for heavy traffic, which it is intended to hold from Tuesday, May 24th, next year, until the following Friday. It is stated that the chief object of the trials is to arrive at a type of heavy motor wagon suitable for trade requirements in Liverpool and neighbourhood, which shall be capable of economically taking the place of horse haulage, and of competing with the existing railway rates, in the transport of heavy loads of goods over considerable distances.

Lectures.—On Thursday last week, before the Glasgow University Engineering and Physical Societies, Dr. Magnus M'Lean lectured on "Lord Kelvin's Patents." He described some of the 45 patents which Lord Kelvin had taken out during 36 years, and a number of instruments were exhibited.

On Thursday, last week, Captain Kennedy, R.E., lectured at the Exeter Literary Society on "Wireless Telegraphy."

Insulated Wire Consolidation in America.—According to the New York *Electrical Engineer* there has for some time past been a movement among the manufacturers of insulated wires and cables in America for a general consolidation of their interests. At the present moment, the matter is one of universal gossip in the trade. Originally, a plan of pooling was proposed, but now, it is said, some 15 or 16 makers are likely to get together in one organisation, closing up all but five or six of the best factories, but retaining all the popular brands and trade marks. The manufacturers themselves are unwilling to talk freely on the subject, but it is believed that the deal is now well advanced, including other arrangements by which, for certain concessions, the new company will agree to buy the chief raw materials from certain parties. It is said that the deal will not, if carried through, involve much actual handling of cash. The total amount of insulated wire and cable made in America can only be conjectured by outsiders. Probably $10,000,000 per year is a safe figure. Owing to the late cutting in prices, most of that has of late been sold with little profit. In a subsequent issue our contemporary refers to the opinions of the electrical trade regarding the consolidation. It is stated that the wire companies are all agreed save one, and that the proprietor of Kerite, who denies his intention to sell out, if the consolidation scheme is carried into effect it is declared that there will be a saving of $500,000 per annum in managerial and selling expenses which would pay a good dividend on a capital of $5,000,000. An instance of business vigilance which we suppose is not without its parallel in this country, is quoted. To secure a recent order eleven principals were on the ground for about a week, their total expenses coming to from £300 to £400. It is clear that with the amalgamation only one-eleventh of that sum would need to be expended, or possibly no one would need to go at all, as the order would come of itself, there being no competitors.

The Cowper-Coles Parabolic Reflector.—The Cowper-Coles parabolic reflector, which is made out of copper faced by palladium, the whole being made by electro-deposition, has recently been tested at Portsmouth, where it is said to have been found that after firing several shots through the reflector the beam was little affected. On the other hand, the first shot that was fired at a glass reflector completely destroyed it. The War Office have for some time been trying this reflector, and have now ordered six 3 feet reflectors to be tried on various forts. The process for the manufacture of these reflectors was briefly referred to in a former issue.

Concert.—On Monday evening last, at the Holborn Restaurant, a Bohemian Concert, given by the Committee of the Telephone Athletic Association, was held, Mr. W. E. L. Gaine, of the National Telephone Company, presiding.

The Counter E.M.F. of the Arc.—This question is never ending. Recently two experimenters tried, by a calorimetric method, to prove the non-existing C.E.M.F., arguing that if the same current in ordinary resistances gave off the same heat as the arc, there could be no counter E.M.F. A fallacious conclusion; for, given a counter E.M.F., its presence cannot produce heat, or any other form of energy. The strong argument for the counter E.M.F. and the point that requires explanation, either by a counter E.M.F. or otherwise, is that we cannot pass a current and strike an arc between two carbon points with less than something like 32 volts; this fact compels explanation. If there is no counter force of some kind, the reason why an arc cannot be struck under a certain E.M.F. has yet to be given. The behaviour of an arc after it has been struck, and the volts are up to 40 or 45, has little or no bearing on the subject. Those people who scoff at the existence of a counter E.M.F. generally talk of the variations of current and E.M.F. in a good going arc, and altogether neglect the important fact that there is a minimum value of impressed E.M.F. under which no arc can be maintained; and without otherwise accounting for this phenomenon, it is reasonable enough that some authorities should accept a counter E.M.F. as the explanation.

"Short" Railway Motors.—From American exchanges we learn that Prof. Sydney Short has assigned his English gearless motor patents to the British Thomson-Houston Company, and that spring-suspended machines of this type are to be employed on the Central London Railway.

Presentation.—Mr. J. Reid Dick, who has for some years been employed at the Brighton Corporation electricity works, left there a few days ago, and was presented with a gold half-hunter non-magnetisable watch and a gold Albert chain by his colleagues and friends.

Lectures on "Magnetism."—Prof. Ewing is to deliver a course of ten afternoon lectures at the Free Church College, Aberdeen, on "Magnetism." The first lecture will be given on Thursday, 9th inst., and the others will be delivered on the 10th, 13th, 14th, 15th, 16th, 17th, 20th, 21st, and 22nd. They are known as the "Thomson" lectures for the 1897-98 session. We have before us a syllabus of the course.

NEW COMPANIES REGISTERED.

Woodlands Electric Company, Limited (54,839).—Registered November 16th with capital £1,000, in £1 shares (800 preference), to carry on the business of electrical engineers, fitters, and metal workers. The subscribers (with one share each) are:—R. Hope-Jones, 55, Argyle Street, Birkenhead, electrician; J. G. Jones, 160, Bedford Road, Rock Ferry, manager; A. E. Woodland, 30, Rodney Street, Birkenhead, scientific instrument maker; J. E. Hird, 6, Ceanwys Grove, Tranmere, Cheshire, cashier; A. Foxworthy, 23, Lowwood Road, Birkenhead, secretary; W. M. Jones, 7, Beaconsfield Road, Tranmere, Cheshire, clerk; J. H. Nuttal, 45, The Woodlands, Birkenhead, organ builder. Registered without articles of association by Rowcliffes, Rawle & Co., Bedford Row, W.C.

Electric Steam Syndicate, Limited (54,856).—Registered November 17th with capital £25,000, in £1 shares, to adopt an agreement with J. H. Dunn to manufacture, sell, and let on hire, apparatus for producing and for superheating steam by means of electricity. The subscribers (with one share each) are:—W. Weston, 25, Budge Row, E.C., printer; C. R. Sims, 4, Elm Grove, Cricklewood, clerk; W. P. Lineham, 82, Queen's Head Street, N., clerk; J. Chinn, Powell Road, Buckhurst Hill; W. C. Cropper, 16, Finsbury Circus, E.C., chartered accountant; D. W. Ackery, 16, Finsbury Circus, E.C., clerk; W. J. Treleaven, Caerhays, Streatham Common, insurance broker. Table "A" mainly applies. Registered by Scott and Co., 15, Queen Street, E.C.

T. Cooke & Sons, Limited (54,848).—Registered November 17th with capital £70,000, in £1 shares (2,500 £5 per cent. cumulative preference), to acquire the business carried on by T. Cooke, R. Wigglesworth, and A. Taylor at Buckingham Works, York, and at 8, Victoria Street, Westminster, as "T. Cooke & Sons," to enter into a certain agreement, and to carry on the business of engineers, optical instrument manufacturers, opticians, scientific instrument manufacturers and dealers, electricians, electrical engineers, photographic instrument manufacturers, &c. The subscribers (with one share each) are:—T. Cooke, 17, Fulford Road, York, optician; R. Wigglesworth, Elmbourne Road, Balham, S.W., gentleman; A. Taylor, Polvellan, Holgate, York, engineer; H. D. Taylor, Trenfield, Holgate, York, optician; W. P. Burkinshaw, Hessle, near Hull, chartered accountant; G. A. Gale, Southfield, Hessle, near Hull, chartered accountant; J. Teasdale, The Avenue, Clifton, York, solicitor. The number of directors is not to be less than three, nor more than five; the first are the three first subscribers; qualification £1,000. Registered by Jordan & Sons, Limited, 120, Chancery Lane, W.C.

Heath, Snoxell & Co., Limited (54,870).—Registered November 18th with capital £10,000 in £1 shares to acquire and carry on the business of an electrical engineer now carried on by W. H. Heath, at 39, Frederick Street, Birmingham, as "W. H. Heath and Co.," and to acquire and carry on the Apollo Foundry, Blews Street, Newtown Row, Birmingham, and to enter into a certain agreement. The subscribers (with one share each) are:—W. H. Heath, 39, Frederick Street, Birmingham, electrical engineer; G. E. Snoxell, 123, Trinity Road, Handsworth, electrical engineer; W. K. Heath, 39, Frederick Street, Birmingham, elettro-plater: C. H. Fisher, 123, Lionel Street, Birmingham, manufacturer; A. C. Jaques, 102, Colmore Row, Birmingham, solicitor; G. W. Elcock, 72, Oxford Road, Handsworth, accountant; J. J. Ogley, 67, Great Brook Street, Birmingham, cashier; C. Richards, Cobden Chambers, Birmingham, chartered accountant. The number of directors is not to be less than three nor more than five. The first are W. H. Heath, G. E. Snoxell, and C. H. Fisher. Qualification, 200 shares; remuneration as the company may decide. Registered office, Apollo Iron Works, Blews Street, Birmingham.

Rose & Bird, Limited (54,905).—Registered November 20th, with capital £10,000 in £1 shares, to adopt an agreement with a company of the same name, and its liquidator, and to carry on the business of electricians, mechanical engineers, and electric lamp and apparatus manufacturers. The subscribers (with one share each) are:—T. A. Rose, 24, Stamford Street, S.E., electrical engineer; A. H. Rose, 24, Stamford Street, S.E., electrical engineer; G. Battison, 5, Templeton Place, Earl's Court, stockbroker; H. W. Shalwell, 35, Walbrook, E.C., surgeon; E. H. Jones, 5, John Street, Bedford Row, W.C., solicitor; G. E. Webb, 23, Bucklersbury, E.C., solicitor; V. Radcliffe, 30, Bedford Row, W.C., solicitor. The number of directors is not to be less than three, nor more than seven. The first are: A. R. Harvey, J. Chadburne, G. Battison, T. A. Rose, C. Walker, and A. H. Rose (managing director); qualification, £200; remuneration as fixed by the company. Registered by Bate, 30, Bedford Row, W.C.

White and Middleton Gas Engine Company, Limited (54,876).—Registered November 19th with capital £200,000 in £1 shares, to adopt an agreement with the Gas Engine (Endland) Development Syndicate, Limited, and to manufacture, sell, and deal in the "White and Middleton gas engine," and any gas, oil, electric, and steam engines, cycles, motor carriages, motors, &c. The subscribers (with one share each) are:—T. Marriott, 11, Old Jewry Chambers, E.C., solicitor; J. Curwen, 21, Water Street, Liverpool, merchant; G. Gerrish, 167, Strand, W.C., clerk; H. Caswell, 29, Great Eastern Street, E.C., manager; W. M. Inglis, 5, Clement's Inn, W.C., secretary; A. K. Walker, 2, Dagmar Villas, Wood Green, journalist; W. Taylor, 54, Earlsfield Road, Wandsworth Common, engineer. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £250; remuneration, £750 per annum, divisible. Registered by Walker and Rowe, 8, Bucklersbury, E.C.

Collin's Cinematographe Syndicate, Limited (54,928).—Registered November 24th with capital £7,000, in £1 shares, to acquire, own, and work any patents, rights and inventions relating to the taking, projecting, production, and exhibition of animated and other photographs, pictures, prints, &c. The subscribers (with one share each) are:—H. E. Jerome, 28, Oakley Road, Bromley Common, Kent, clerk; A. Harris, 17, Church Street, Lesson Grove, N.W., merchant; H. Green, 5, Colville Terrace, Bayswater, W., secretary; C. Rossner, 193, Brixton Hill, S.W., gentleman; C. T. Wilkinson, 2, Martin's Lane, E.C., solicitor; F. Dawkins, 13, Grangecourt Road, Stamford Hill, accountant; W. C. Edwards, Canbury Avenue, Kingston-on-Thames, civil engineer. Table "A" mainly applies. Registered by Douglas Norman & Co., 4, New Court, Lincoln's Inn.

Electrical Guarantee and Trust, Limited (54,954).—Registered November 25th with capital £250,000 in £5 shares, to acquire and carry on business as financiers, promoters, bankers, underwriters, concessionaires, contractors, merchants, &c., and to promote, construct, equip, maintain, and work any railways, tramways, telegraphs, telephones, cables, ships, &c. The subscribers (with one share each) are:—C. T. Price, 2, Prince Arthur Road, Hampstead, solicitor; R. Mackenzie, Chudleigh, Merstham, Surrey, solicitor; W. Henderson, 10, Comyn Road, S.W., engineer; H. H. James, 4, Bloomfield Place, S.W., gentleman; G. Graham, 86, Harbut Road, S.W., accountant; N. G. Newington, 76, Ondine Road, East Dulwich, clerk; A. Benwell, 10, Machell Road, Nunhead, S.E. The number of directors is not to be less than two nor more than four; the subscribers are to appoint the first; qualification, £1,000; remuneration, £200 each per annum. Registered by Renshaw & Co., 2, Suffolk Lane, E.C.

Automatic Electric Meter Syndicate, Limited (54,961).—Registered November 25th with a capital of £32,000, in £5 shares, to enter into an agreement with W. D. Watson, of Rochdale, and others, and to carry on the business of electric meter manufacturers and dealers, and electricians. The subscribers (with one share each) are:—J. B. Atherton, Rough Grange, Gateacre, manufacturer; T. Snape, J.P., The Gables, Croxteth, Liverpool; G. Ellis, J.P., Landguard, Southsea, Hants; W. D. Watson, Falinge Road, Rochdale, manufacturer; J. Atherton, 11, Charing Cross Road, W.C., manufacturer; A. E. Haptie, 5, Durham Road, Seaforth, Liverpool, cashier; F. W. Lintern, 104, Northbrook Street, Liverpool, clerk. The number of directors is not to be less than three nor more than five; the first are—T. Snape, J. Atherton, and G. Ellis. Qualification £1,000; remuneration £100 each per annum, and an extra £50 each in respect of any year in which 3,000 meters shall have been sold. Registered by J. F. Leslie & Co., 15, Newman Court, Liverpool.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

White, Jacoby and Company, Limited (52,494).—This company's statutory return was filed on September 22nd, when 2,357 shares were taken up, 2,250 are considered as paid, and nothing has been called on the seven others.

Standard Dynamo and Motor Manufacturing Company, Limited (48,471).—This company filed a notice on October 28th, notifying that the members have resolved to wind up the concern, and have appointed William Beanland, C.A., of 35, Hustlergate, Bradford, the liquidator.

Bickle and Company, Limited (36,429).—This company's annual return was filed on September 2nd, when 2,027 shares were taken up out of a capital of £50,000 in £10 shares. 1,000 are considered as paid, and £10 per share has been called on the rest. £10,223 has been paid, and £50 is in arrears. £3 has been paid on forfeited shares.

Headland's Patent Electric Storage Battery Company, Limited (45,524).—This company has, by notice filed October 20th, increased its capital from £15,000 to £20,000 in £1 shares.

Weymersch Electric Battery Syndicate, Limited (32,858).—This company's annual return was filed on September 7th. The capital of £20,000 in £5 shares has been taken up in full, and 3,000 shares are considered as paid; £5,000 has been paid on the rest.

Premier Electric Lamp Syndicate, Limited (54,745).—The registered office of this company is situate at 15, Union Court, Liverpool.

Power and Traction, Limited (54,749).—The registered office of this company is situate at 79, Palace Chambers, Westminster, S.W.

Dixon & Corbitt and R. S. Newall & Co, Limited (24,228).—This company's annual return was filed on September 1st. The capital is £120,000 in £10 shares (6,000 preference). All the ordinary and 1,956 of the preference shares have been taken up, and all the ordinary and 250 preference are considered as paid; £8 per share has been called on the rest, and £13,648 has been paid.

Electrical Coal-Cutting Contract Corporation, Limited (36,643).—The annual return of this company was filed on November 22nd. The capital is £402,000 in 60,000 ordinary shares of £5, 20,000 deferred shares of £5, and 2,000 founders' shares of £1 each; 9,531 ordinary, 20,000 deferred, and 2,000 founders' shares have been taken up, and 4,000 ordinary and 20,000 deferred are considered as paid. The full amount has been called on the others, and £28,375 has been paid, leaving £1,280 unpaid.

CITY NOTES.

The Gutta-Percha Corporation, Limited.

Subscriptions are invited to this undertaking, which has been formed with a capital of £200,000, in 80,000 preference shares and 80,000 ordinary shares. The objects of the company are to trade in and manufacture, under Prof. Serullas' patents for obtaining gutta-percha from the leaves and twigs of gutta-percha trees. The process has been referred to many times in the Electrical Review, and a former prospectus was exhaustively criticised in our issue of July 9th. The gutta is extracted from the leaves and twigs by means of a chemical solvent, the one employed by Prof. Serullas being toluene.

The capital is a large one, and though general report speaks well of the gutta obtained by this process, we are doubtful whether it is worth the price demanded by the vendors, viz., £150,000. The weak feature of the scheme is that the company will only acquire the right of extracting gutta in a particular way, that is by the use of a special solvent, and a W. Ramsay, the same initial, by the way, as that of the Professor who so favourably reports upon it, has since been granted a patent for doing the same thing by rosin oil. They cannot hope to prevent other people from extracting gutta from leaves and twigs by means of a solvent that is not covered by their patents, and we may depend upon it some ingenious chemist will soon find yet another way of doing it. We shall be very much surprised if the public will consent to pay £150,000 for a system which gives them no monopoly. Most eloquent testimony is produced as to the quality of the material made by the Serullas process; but no matter how much better it may be than the gutta-percha on the market, we must confess that the financial side of the scheme does not impress us as being particularly sound.

The Electric Construction Company, Limited.

An issue of £200,000 4 per cent. perpetual first mortgage debenture stock is announced, which is to be applied to redeeming the present 6 per cent. debenture stock, £150,000 of which will fall due on January 15th, 1901. While there are many people who object to perpetual charges of any sort, we cannot help thinking it is by no means a bad scheme, for the issue will provide the company with extra working capital, and will, moreover, reduce the debenture interest from £9,000 to £8,000, which is a consideration. On the whole, we wish the company every success in the issue.

The London Electrical Omnibus Company, Limited.

A meeting of shareholders, convened by Mr. Wm. Marshall, formerly a director and deputy chairman of the company, was held at Cannon Street Hotel on Friday last, to discuss the affairs of the company.

Mr. Kimber presided over the proceedings, and in his remarks said the directors had not called the ordinary meeting of the company, in order to place the position of affairs before the shareholders. Although Mr. Marshall's circular pointed out unsatisfactory features in the company, he, the chairman, had great faith in the concern, although nothing had yet been accomplished. The object of the present meeting was to inquire whether something could not be done to preserve their property, and to place the undertaking on a better footing. The chairman then went through the various statements contained in the original prospectus, and pointed out that not one of them had been fulfilled.

Mr. William Marshall then made a statement to the company, the principal points being that he was an original director and promoter of the company, but had not been at any meeting of the board since last year. He had tried hard to get 'buses out, but had not succeeded. The directors had promised to have almost immediately 125 'buses out, and they had ample capital to do it with. When the company paid him, as vendor, £20,000 which was due to him, he saw the company had gone to allotment with too small a capital; he returned the cheque, and gave them a cheque for £13,000 for contributing shares. The directors shortly after taking office voted themselves £3,000 a year, with a bonus on the profits, and had also appointed Mr. Ward engineer at a salary of £1,200 a year. In their circular of August 24th, the directors stated that the prospects of the company were better than heretofore, and that they were buying an interest in the Solar accumulator, which had not been sufficiently tested. He believed the directors did not hold any more than their qualifications. Under the circumstances, he thought a committee of investigation should be appointed. He had heard that the London General Omnibus Company had entered into a contract to put 400 electric omnibuses on the streets, and therefore they were far behind that company. After some discussion a resolution was passed, appointing a committee consisting of five shareholders, to investigate the affairs of the company.

Crompton & Co., Limited.

An extraordinary general meeting was held on Monday last at the Cannon Street Hotel, Mr. John Trotter presiding, for considering resolutions referring to the reduction of capital. We have given the principal features of the scheme in previous issues, and the following three resolutions show the nature of the reforms—(1) reducing the capital of the company from £280,000 to £168,000, the reduction to be effected by cancelling capital to the extent of £2 per share upon all the existing 34,108 shares which have been issued, and by reducing the nominal amount of the shares in the company's capital from £5 to £3 per share; (2) further reducing the capital from £168,000 to £162,000 by cancelling 2,000 ordinary shares of the company, numbered 1,393 to 2,784, and 6,785 to 7,392, both inclusive, issued as fully paid up; and (3) providing that as from the date of the reduction of capital mentioned in the last resolution, the holders of the 38,180 preference shares should cease to be entitled to any preference or priority, either in respect of past or future dividends or capital, over the holders of the ordinary shares.

The Chairman, in proposing the first resolution, stated that the subject-matter of the scheme submitted to them had already been placed fully before them—in circulars which had been sent to them, and at their meeting last July. The board had gone very carefully into the whole question, and had taken into account the whole of the circumstances as affecting the two classes of shareholders, with the result that they recommended the scheme now before them. The shareholders had evidently gone into the matter with great care, and he might state that the board had received 24,000 votes in favour of the scheme. He then proposed the first resolution.

Mr. R. E. B. Crompton seconded the motion.

Mr. Thomas Huntley objected to the preference shareholders being called upon to give up their arrears of dividend, and he considered that they ought to receive some compensation for doing so.

The Chairman said that there was a large amount of arrears due on the cumulative preference shares, but this could only be paid out of future profits. Under the scheme now submitted, the preference shareholders would receive the whole of the future profits, less one-eighth.

Colonel Stebbing objected to their rights as preference shareholders being taken from them.

The resolution was eventually put to the meeting, and carried with one dissentient. The second resolution was also carried in the same way. For the third resolution 17 voted, and there were nine against it. The value of the votes was thereupon taken, when the chairman declared it carried by the requisite majority, there being 24,038 votes in favour of it, and 606 against it. Separate meetings were then held of preference and ordinary shareholders, at which resolutions were carried permitting the carrying into effect of the resolutions carried at the previous meeting.

Stock Exchange Notices.—The Committee has appointed a special settling day, as under:—Thursday, December 9th—Direct West India Cable Company, Limited—Scrip (£60 per cent. paid) of £120,000 4½ per cent. debentures.

The Electric and General Investment Company, Limited.—The directors have declared an interim dividend of 10 per cent. on the capital paid up on the ordinary shares, payable on December 15th.

Royal Electric Company of Montreal, Limited.—A quarterly dividend of 2 per cent., being at the rate of 8 per cent. per annum, has been declared.

G. R. Blot & Co., Limited.—We understand that the allotment letters of the above company were posted 1st December.

TRAFFIC RECEIPTS

The City and South London Railway Company. The receipts for the week ending November 28th, 1897, were £1,069; week ending November 29th, 1896, £1,054: increase, £6; total receipts for half-year, 1897, £20,783; corresponding period, 1896, £20,895; decrease, £112.

The Liverpool Overhead Railway Company. The receipts for the week ending November 28th, 1897, amounted to £1,257; corresponding week last year, £1,148; increase, £109.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending November 26th, 1897, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,963.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1894.	1895.	1896.	Closing Quotation, Nov. 24th.	Closing Quotation, Dec. 1st.	Business done during week ended December 1st, 1897. Highest.	Lowest
149,900£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	4 %	...	101 - 105	101 —1.5	...	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	5½ — 6½	5½ — 6½	...	...
923,960£	Anglo-American Teleg., Ltd.	Stock	£2 2s.	£2 9s.	£2 13s.	58 — 60	58 — 60	58½	58
3,038,020£	Do. do. 6 % Pref.	Stock	£4 4s.	£4 18s.	£5 6s.	104 - 105	104 - 105	105	104¼
3,038,920£	Do. do. Defd.	Stock	...	...	...	12¼ — 12⅝	12¼ — 12⅝	...	...
130,000	Brasilian Submarine Teleg., Ltd.	10	7 %	7 %	...	16 — 16½	16 — 16½	16⅜	16 1/16
75,000£	Do. do. 5 %, Debs., 2nd series, 1926	100	5 %	5 %	...	114 - 118	114 —118	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	2½%	4 %	4 %	3¼ — 3⅜	3 — 3½	3	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	182 —187	183 —188	186½	186
653,586£	Do. Do. Sterling 500 year 4% Deb. Stock Red.	Stock	...	...	...	105 —107	105 —107	106¼	105¾
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	1½%	1½%	2 %	3/16 — 5/16	3/16 — 5/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	8½ — 9½	8½ — 9½	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½ — 19½	18½ — 19½	18⅝	18⅝
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	4 %	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 11	10 — 11	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000	50	4½%	4½%	4½%	103 —106 %	103 —106%	104	...
60,710	Direct United States Cable, Ltd.	20	2 %	2½%	2½%	10 — 10½	10 — 10½	10⅜	10 1/16
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½%	6½%	6½%	17 — 17⅛	17 — 17½	17⅜	17 1/16
70,000	Do. 6 % Cum. Pref.	10	6 %	6	6%	18 — 19	18 — 19	...	...
89,900	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	5%	101 — 1 4	101 —104	...	...
1,302,615	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4%	130 —133	131 —134	131¼	...
250,000	Eastern Extension, Australasia and China Teleg., Ltd.	10	7 %	7 %	7⅛	18½ - 18⅝	18½ - 18⅝	18⅝	18½
35,500£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,042, 3,976 to 4,326	100	5 %	5 %	5%	100 - 1 4	100 —104	...	...
133,100£	Do. do. Bearer, 1,050—3,975 and 4,227—6,400	100	5 %	5 %	5%	101 — 104	101 —104	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	4%	131 —134	131 —134	...	...
51,100£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	5%	100 - 104	100 —104	...	...
69,200£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	5%	101 —104	101 —104	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4 %	4%	103 - 106	103 —106	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4%	108 —111 %	108 —111%	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	4½%	4½%	4½%	11½ — 12	11½ — 12	11⅞	11 11/16
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6%	17½ - 17⅝	17⅜ - 18	17¾	17½
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅝%	10 %	10⅜	26 — 27	26 — 27	...	...
160,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	5⅛	102 —105	102 —105	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10⅜	52 — 55	52 — 55	...	...
100,000£	London Platino-Brasilian Teleg., Ltd. 6 % Debs.	100	6 %	6 %	6%	107 —1.0	107 —110	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000	5	4 %	4 %	...	2 — 2½	2 — 2½	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5 %	5½%	5½%	6¼ — 6½	6¼ — 6½	6 7/16	6¼
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	15 — 17	15 — 17	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	14 — 16	14 — 16	14½	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	5 %	6 — 6½	6 — 6½	6 1/16	...
130,766	Do. do. Nos. 119,235 to 250,000, £4 paid	5	...	...	...	4⅜ — 5¼	4⅜ — 5¼	...	...
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	104 —109	104 —109	106½	105
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	4½%	5 %	5 %	9/16 — 11/16	9/16 — 11/16	...	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	4 %	107 —110	107 - 110	...	...
11,839	Reuter's Ltd.	8	nil	5 %	5 %	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	136 —141	136 - 141	...	...
58,000	United River Plate Teleph., Ltd.	5	3 %	4 %	...	3⅜ — 4½	3⅜ - 4½	...	...
146,733£	Do. do. 5 % Debs.	Stock	5 %	5 %	...	102 -107	102 —107	...	...
15,609	West African Teleg., Ltd., 7,561 to 23,169	10	nil	4 %	nil	4½ - 5½	4½ - 5½	...	...
213,400£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	103 - 106	103 —106	...	...
64,256	Western and Brasilian Teleg., Ltd.	15	3 %	3 %	2 %	9¼ — 9⅝	9½ - 10	9 1/16	...
33,129	Do. do. do. 5 % Pref. Ord.	7½	5 %	5 %	5 %	7½ — 8	7¼ — 7⅞	7⅞	7½
33,129	Do. do. do. Def. Ord.	7½	1 %	1 %	...	2¼ — 2⅝	2½ — 3	2⅝	2⅜
382,230	Do. do. do. 4 % Deb. Stock Red.	Stock	...	...	...	106 —109	106 —109	107½	...
88,321	West India and Panama Teleg., Ltd.	10	⅛%	⅛%	1 %	⅜ - ⅝	⅜ - ⅝	⅝	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	7¾ - 8½	8¼ - 8¾	8⅛	8
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	5 — 7	5 — ?	...	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,600	100	5 %	5 %	5 %	107 —110	107 —110	...	...
1,163,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds	$1000	7 %	7 %	7%	103 —107	103 —107	...	...
160,100£	Do. do 6 % Ster. Bonds.	100	6 %	6 %	6%	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	4½%	5 %	6 %	12 — 13	12 — 13	12⅝	...
20,000	Do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	6⅝	...
26,000	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277	5	5 %	5 %	5 %	10¼ — 10⅝	10½ — 11	10⅝	10⅜
60,000	Do. do. do. 4½ % Deb. Stock Red.	Stock	...	4½%	4½%	113 —116	113 —116	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	5 %	5 %	7 %	27 — 28	26½ — 27½	27⅞	26⅝
10,000	Do. do. Prov. Certs.	5	...	...	...	26¼ — 27½	26 — 27	...	...
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	17 — 18	17 — 18	17⅝	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	131 —136	131 —136	135	133½
22,475	County of Lond. & Brush Prov. E. Ltg. Ltd., Ord. 1—22,475	10	...	nil	nil	13⅜ — 14¼	14½ - 15	14 13/16	13⅞
20,000	Do. do. do. 6% Pref., 40,001—60,000	10	...	6 %	6 %	15½ — 15⅝	15½ — 15⅝	15⅝	...
10,000	House-to-House Elec. Light Supply, Ord., 101 to 10,100	5	...	...	...	9¼ — 9⅜	9½ — 9⅝	...	...
10,000	Do. do. 7 % Cum. Pref.	5	...	...	...	11 — 11½	11 — 11½	11½	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000	10	3 %	4 %	5 %	18⅜ — 19¼	18⅜ — 19¼	19½	18 13/16
12,500	Do. Ord., 50,001—62,500, iss. at £2 prem.	10	...	...	...	18 — 19	18 — 19	...	...
220,000£	Do. 4½% first mortgage debenture stock	...	4½%	4½%	4½%	119 —123	119 — 123	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	1 %	2 %	4 %	16½ — 17½	16½ — 17½	17⅝	16⅝
19,980	*St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	6½%	7½%	10½%	16½ — 17½	16½ — 17½	...	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	10 — 11	10 — 11	...	...
50,000	Do. do. 4 % Deb. stock Red.	Stock	...	...	...	103 —106	103 —106	...	...
43,341	South London Electricity Supply, Ord., £2 paid	5	...	...	...	2⅝ — 2⅞	2⅝ — 3	2 13/16	2 9/16
67,900	Westminster Electric Supply Corp., Ord., 101 to 68,000	5	5 %	7 %	9 %	15 — 16	15 — 16	15⅝	15⅜

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred share warrants, profits ring used as capital.
‖ Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of he next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1894.	1895.	1896.	Closing Quotation Nov. 24th.	Closing Quotation, Dec. 1st.	Business done during week ended Dec. 1st, 1897. Highest.	Lowest.
20,000	British Electric Traction	10	...	...	...	12⅜ — 13¼	12⅜ — 13¼	13 3/16	13
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000...	3	2½%	...	...	1⅝ — 1⅞	1¾ — 2	1⅝	1⅝
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	3 %	...	...	2⅛ — 2⅜	2⅛ — 2⅜	2 3/16	2⅛
125,000£	Do. do. 4½ % Perp. Deb. Stock.... ...	Stock	4½%	...	...	107 — 111	107 —111	109⅝	...
76,770	Do. do. 4½% 2nd Deb. Stock Red. ...	Stock	...	...	...	98 —102	98 —102	...	...
19,126	Central London Railway, Ord. Shares	10	...	...	...	9⅜ — 10¼	9⅜ — 10¼	...	...
143,106	Do. do. do. £6 paid	10	...	...	...	5½ — 6	5½ — 6	...	...
58,830	Do. do. Pref. half-shares £1 pd. ...	...	...	...	...	1 — 1⅛	1 — 1⅛	...	...
61,777	Do. do. Def. do. £5 pd. ...	...	...	...	...	4 — 4½	4½ — 4⅝	4½	4⅜
630,000£	City and South London Railway	Stock	1½%	1 3/16%	1 9/16%	69 — 71	68 — 70	70½	68
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	*nil*	*nil*	...	1⅜ — 2¼	1⅜ — 2¼	...	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	5	5 %	5 %	5⅛%	2¼ — 2⅜	2½ — 3	2 13/16	2½
17,139	Do. do. do. "A" Shares 01—017,139	5	5 %	5 %	5⅛%	4 — 5	4 — 5	4⅜	4⅛
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	5 %	6 %	2⅜ — 2⅝	2⅜ — 2⅝	2½	2⅜
16,343	Do. do. 7 % Cum. Pref., 1 to 16,343 ..	2	7 %	7 %	7 %	3½ — 3⅝	3½ — 3⅝	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	...	...	⅛ — ¼	⅛ — ¼	...	...
67,275	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	...	...	½ — ¾	½ — ¾	...	...
9,600£	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	*nil*	10½%	...	9 — 11	9 — 11	...	...
12,500	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	6 %	8 %	10 %	20 — 21	20 — 21	...	...
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	7 %	18½ — 19½	18½ — 19½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	4½%	4½%	110 — 115	110 —115	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	10 %	10 %	10 %	22 — 23	23 — 24	23½	22¼
300,000	Do. do. do. 4 % 1st Mort. Debs	100	...	...	...	103 —107	103 —107	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	1¼%	2⅛%	2⅛%	11½ — 11⅝	11½ — 11⅝	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	16 — 16½	16 — 16½	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	15 %	15 %	36 — 39	36 — 39	37½	...
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	102 —105	102 —105	...	...
54,000£	Waterloo and City Railway, Nos. 1 to 54,000	10	...	...	...	12½ — 13	12½ — 13	12⅞	...

Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7%; 1896—6%.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*** Birmingham Electric Supply Company, Ordinary of £5 (£4 paid), 7⅞, £5 (fully paid) 11.**

Electric Construction Corporation, 6 % Debentures, 103—106.

House-to-House Company, 4½% Debentures of £100, 107—110.

Kensington and Knightsbridge Electric Lighting Company, Limited Ordinary Shares £5 (fully paid) 14½—15½; 1st Preference Cumulative 6 %, £5 (fully paid), 8—8½. Dividend, 1896, on Ordinary Shares 7 %.

London Electric Supply Corporation, £5 Ordinary, 2¼—2⅜.

*** T. Parker, Ltd., £10 (fully paid), 11½.**

Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 8—8½. Dividend for 1896—6 %.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (October 14th, 1897).

REVIEWS.

Block Signal Operation: a Practical Manual. By Wm L. Deer. London: E. & F. N Spon, Limited, 1897.

This is a work, consisting of some 270 pages, dealing mainly with the practice pursued in the United States in the protection and regulation of railway traffic. The book is published both in New York and London, and the author in the short preface, with which the subject matter of the work is introduced, explains that the slight reference made to the mode of signalling on the lines of railway in England has been introduced by him with a desire that the railways of America might profit by it.

The reference to British railways is not very great. It is practically confined to the mode of block signalling on the London and North Western; still, the work will be found of some service to those who are interested in the important work of regulating railway traffic—in comparing some of the methods employed here with some of those in operation in the States. The conditions, of course, are, as a rule, vastly different, except where we come to large towns where railways conflict the one with the other, and where the traffic is more dense and more congested. At such points there can be little doubt of the propriety of adopting the most perfect and reliable means for governing the traffic in such a manner as will insure safety to the travelling public.

It must not, however, be understood from this that Mr. Deer devotes himself to a technical description of any one system. His object appears to be to lay down from his own practical experience those features of importance in the application of block signalling which should dominate the mind of the operator as well as the controller. With this view his remarks on the principles which should be considered when selecting a block system for use upon certain systems or portions of systems, commend themselves to the consideration of those whom the question affects—chiefly the American lines. Here in England we may class the mode of "block" working broadly under two heads, the ordinary block where the electrical portion of the apparatus is independent of the signals which actually govern the trains, and that under which the mechanical signals are interlocked with the electrical, so that the former cannot be prejudicially operated without the action of the latter. According to Mr. Deer, the block systems in general use in America come under the following denominations—"manual," "controlled manual," "auto-manual," "automatic," and "machine." Defined, this means that the term "manual" indicates that the signals of a block-post are operated and controlled by the signalman at that post. "Controlled manual," that the signals are controlled—electrically or mechanically—by the signalman at the station in advance, but operated by the man at the entrance to the block section. "Auto-manual," that the signals are replaced in the danger position automatically by the train after the near car passes them. "Automatic," as the term indicates, is entirely automatic, generally through the agency of electricity or of a "combination of electricity and compressed air." "Machine blocking is a method of controlling the traffic on single lines," in which are used, in connection with the ordinary outdoor signals, certain machines with detachable parts and worked mechanically, except that they are unlocked electrically." Chapters are devoted to each of the principal modes here referred to, and where opportunity occurs, as, for instance, when dealing with the "manual" system, and again with the "machine" system, the author produces the Instructions issued by the London and North Western Company for the manipulation of their ordinary three-wire system of block signalling and that applicable to the Webb & Thompson electric staff system. Of course, our readers will be aware that Tyer with

his Tablet block pioneered this mode of working, and that the "Tablet" is very largely used in England, the colonies, and on Continental lines; but although it is referred to by Mr. Deer, apparently it has not made so much progress in the States as elsewhere, as the method of work described is wholly that of the Webb & Thompson. As our readers are aware, automatic block signalling is employed to some extent on American railways. The nomenclature of the various types is interesting. We find that the signals usually employed are the "banner," or the "banjo" or disk type, except that used with the electro-pneumatic system, where the signals are of the semaphore form. "The banner signal is usually circular," with openings to relieve it from wind pressure. It rotates a quarter circle. Signals of the disk pattern are enclosed in a glazed case. When at danger the disk is displayed through the glass covered front, but Mr. Deer does not tell us how the signal fares in frost or snow.

In England very few, if any, devices are used for compensating the variations of the wire which works the signal, due to changes of temperature. From Mr. Deer we learn that where signal wires are over 1,000 feet in length, they are often provided with an automatic adjusting device. Dealing with the signal itself, the author points out that the colour of the semaphore blade has nothing to do with the signal indication; position and shape are the governing factors. On some lines "distant" signal blades are painted green with a broad white stripe across the far end of the arm. For night signals white is usually employed to denote "safety," red "danger," and green "caution." The position of the arm in relation to the signal post in its government of the road is the reverse to that adopted on English railways. Here the arm which governs the road in advance stands to the left of the post as viewed by an approaching train. In America it stands to the right-hand side. Judged by the rules of the Erie Railroad permissive block working is allowed—that is, a train may after the lapse of a certain time, and subject to instruction from the "train dispatcher," be allowed to enter a block section before that in the second has been signalled clear of it.

Several pages are devoted to junction working and junction regulations; and typical instructions are produced from those in use on several American lines for manipulating the different types of block referred to. We are not, however, quite with Mr. Deer in his historical deductions. Does the actual operation of the block system date from December, 1839, "when the Great Western Railway of England began telegraphing the arrival and departure of its trains from station to station for a short distance near London." We have always understood that electricity was first applied to this purpose on the Blackwall Railway in 1840. In 1842 Sir William (then Mr.) Cook issued a pamphlet called "Telegraphic Railways," which laid down the fundamental principles of block signalling; and the principle thus enunciated by Sir W. F. Cook received its first practical application on the Norwich and Yarmouth section of the Great Eastern Railway in 1844. The arrangement was cumbersome and costly; and in 1853 or 1854 it was greatly simplified, and, in fact, brought to its present basis by Mr. Edwin Clark. This was at the instigation of Captain Huish, of the London and North Western Railway, upon which line it was employed. It was really an adaptation of the double needle form of telegraph instrument to block signaling purposes.

The book has many features of interest to the railway signalling engineer, more, no doubt, to those engaged in American railway practice than to those who are called upon to administer the service of our English lines; still the latter will find much interesting and instructive reading.

Formulaire de L'Electricien. Par E. Hospitalier. 15th year, 1897. Paris: Masson et Cie, Editeurs, 120, Boulevard Saint-Germain.

The principal alteration in this well-known book appears to be the addition of a French-English-German Technical Vocabulary of 37 pages, compiled by M. Levylier. It is, of course, a difficult matter for a man, no matter how good a linguist he may be, to compile a satisfactory vocabulary of the kind, but in the present instance the work has been done fairly well, although we occasionally find English equivalents which any Englishman would fail to recognise; for example, we have never heard an "anvil" called an "Amboss"; to call a "dipping" needle a "deeping" needle may perhaps be pardoned; altogether there is but little of the "English as she is spoke" style in the compilation.

MECHANICAL FEATURES OF ELECTRIC TRACTION.*

By PHILIP DAWSON.

(*Concluded from page* 779)

Table 11 gives the standard dimensions of bearings and fly-wheels, and the weights, of typical engines now successfully working large tramway stations; the first two examples are engines with fly-wheel governors. The smaller engines are fitted with single piston-valves, and the larger with gridiron valves. In small engines the governor acts on the high-pressure cylinder; but in large engines it is so arranged as to act on both cylinders. Table 12 gives the dimensions of some standard continental engines, most of which are driving rolling mills. On comparing the dimensions of the bearings in this table with those of the tramway engines,

Table 11.—Weights of Engines and Fly-Wheels for Electric Traction.

Description of governor ...			Fly-wheel	Governor		
Power of engine	at economical load ...	I.H.P.	583	1,070	500	800
	maximum ...	I.H.P.	911	1,650	1,000	1,600
Weight of engine ...		lbs.	106,000	177,000	186,000	325,000
		tons	47·4	79·0	83·1	145·0
Fly-wheel	diameter ...	feet	11	15	15	20
	weight ...	lbs.	25,000	45,000	60,000	100,000
		tons	11·2	20·1	26·8	44·6
Bearings	diameter ...	inches	13	15	18	20
	length ...	inches	25	30	34	36
Ratio of length to diameter of bearings			1·92	2·00	1·89	1·80

it will be seen that the ratio of the length of the bearing to its diameter in the tramway engines is generally somewhere near 2 to 1, Table 11; whereas in the engines not designed for tramway work, it is nearer 1½ to 1, Table 12. The main bearings are usually provided with cylindrical shells, which can be taken out by simply jacking up the shaft to take the weight off the bearings. The shells are made hollow for water circulation, which can be used in case the bearings should heat from dirt or other cause; by this means the engine can be enabled to complete its run.

Table 12.—Proportions of Bearings in Rolling Mill and other Continental Engines.

Cylinder	diameter inches	17·7	23·6	23·6 35·4	23·6 39·3	25·6	27·5	49·2
	stroke inches	27½	43	41	39	25½	39	49
Revs. per min. revs.		66	75	60	120	105	100	85
Bearings	diameter inches	6·7	12·6	8·6	9·8	9·6	10·2	17·1
	length inches	10·8	24·4	14·2	14·5	15·7	16·5	23·6
Ratio of length to diameter of bearings ...		1·61	1·93	1·65	1·48	1·63	1·62	1·48

Mean ratio of length to diameter of bearings, 1·63.

Tests.—Table 13 gives the results of tests recently made in a large American station. There are four tandem compound condensing engines: high-pressure cylinder 20 inches diameter, low-pressure 36 inches, stroke 36 inches; initial pressure 125 lbs. per square inch, economical cut-off 5—16ths of stroke in high pressure cylinder; vacuum, 24 inches of mercury; revolutions 103 per minute. These four engines each drive by belt a 500-kilowatt generator, and there is one direct coupled engine, with cylinders 15 and 23 inches diameter, and 17 inches stroke, driving a 200-kilowatt generator. The results may be considered highly satisfactory. Practically the minimum coal consumption is 1·67 lb. per indicatod horse-power, and 2·48 lbs. per electrical horse-power at the switchboard. It therefore appears safe in a well designed and fairly large station to estimate the coal consumption per indicated horse-power at 2 lbs., and per electrical horse-power at not more than 2·66 lbs., so that the coal consumption per Board of Trade unit will not exceed 3·3 lbs.

Fly-Wheels.—The use of fly-wheels in electric traction stations is important. Owing to the need of keeping the angular velocity as constant as possible, especially in large stations where, owing to Board of Trade regulations, polyphase transmissions become a necessity, the fly-wheels have to be much heavier than for ordinary lighting work. The strains they may be called upon to bear occasionally are enormous. The dynamos for tramway work are now

* Read before the Institution of Mechanical Engineers, November 4th.

constructed with such an amount of copper, and with such fire-proof insulation, that they can stand short-circuiting without serious damage. Circuit breakers are of course supplied, and are generally prompt in action; but it may happen, and has occasionally occurred,

Table 13.—Tests of Pratt Street Electric Power Station, City and Suburban Railway, Baltimore.

Date of test, 1895 August	14	16	17	21	Average.
Average indicated H.P. for 20 hours ... I.H.P.	1,860	1,873	1,773	2,000	1,876·5
Average electric H.P. for 20 hours ... E.H.P.	1,395·5	1,405	1,330	1,499	1,407·4
Coal used, total lbs.	75,678	70,885	72,885	74,511	73,490
Coal used per I.H.P. per hour, engines only lb.	1·83	1·70	1 85	1·67	1·76
Coal used per I.H.P. per hour, other machinery lb.	0 20	0·19	0 21	0·19	0 20
Coal used per I.H.P. per hour, entire station lbs.	2·03	1·89	2·06	1·86	1·96
Coal used per E.H.P. per hour, entire station lbs.	2 71	2·52	2 74	2·48	2·61

Coal Consumption.—The above consumptions are based on the total amount of coal actually used in the station for the above electric output, no deductions being made for ash, clinker, or moisture.

Load.—The heaviest load was 781 I.H.P., the lightest 366, and the average during four hours 553 I.H.P.

Generators.—Four 500-kilowatt by General Electric Company, of 670 E.H.P. each, making 2,680 E.H.P.; and one 200-kilowatt, of 268 E.H.P.; total 2,948 E.H.P.

Boilers.—Campbell and Zell water tube, four sets of 700 H.P., making 2,800 H.P. total.

Engines.—Four compound by McIntosh and Seymour, cylinders 20 and 36 inches diameter by 36 inches stroke, of 750 economical I.H.P. each making 3,000 I.H.P.; one compound by same makers, cylinders 15 and 28 inches diameter by 17 inches stroke, of 250 economical I.H.P.; stoker, hoisting and conveying engines of 50 I.H.P.; total 3,300 I.H.P.

Two Blake vertical twin air pumps and condensers, each 1,800 H.P. capacity, making 8,600 H.P.; one horizontal ditto, 250 H.P., total 3,850 H.P. capacity.

Two Blake duplex feed-pumps, 14 and 8½ inches diameter by 12 inches stroke, each 2,800 H.P. capacity, making 5,600 H.P.; two combined pumps and receivers, 6 and 4½ inches diameter by 7 inches stroke, each 4,500 H.P. capacity, making 9,000 H.P.; total 14,600 H.P.

Hunt's coal and ash conveying apparatus. Roney mechanical stokers.

on the Continent; over 90 feet per second is frequently allowed, as seen from some of the tables, whereas in English practice it is not considered safe to go beyond 80 feet. This may possibly be owing to the better quality of cast-iron in America.

Fly-wheels built up of rolled plates, and constructed more like a boiler or a bridge, have been adopted to some extent in electric tramway stations in America. Drawings were exhibitad showing plate constructions of different kinds; and also the construction of a cast-iron wheel 15 feet diameter, and weighing about 49,000 lbs. or 22 tons. These built up wheels generally have a cast-iron centre or hub, with brackets to which the armature is bolted, so as to take some of the strain off the two keys that hold the armature on the shaft. To the centre of the hub are connected segmental web plates, extending to the extreme outside diameter of the wheel. The plates are faced along their edges, so as to form a good joint. Outside of these segments are two circular plates, bolted through each segment and through both plate and hub. The segments are generally braced by truss pieces, held in the centre by cross bolts which act as struts. Outside the web plates surrounding the rim is a strip riveted through the rim; and outside of this is a second strip also riveted through. The rims of these wheels are usually turned down after the wheels have been riveted up and fixed on the shaft.

Accidents to fly-wheels may generally be attributed to three chief causes: firstly, poor castings or internal strains; secondly, faulty design and construction; thirdly, excessive speed. In designing a fly-wheel it is easy to calculate its parts so that it shall be perfectly safe to bring it to a standstill within a given angle. Investigation of some of the best fly-wheels for tramway stations shows that their design permits of their being stopped in less than one revolution, with factors of safety varying from 17 to 18.

Generators.—The kind of generator to be used for electric traction is an important question. As in the case of the engines, tramway generators, Table 14, must stand heavy overloading without damage. Moreover, as one pole is earthed, the greatest care must be taken that the best insulation is used throughout. Since the loads to which they are subject are extremely variable, dynamos as usually constructed for lighting work would require the position of their brushes to be constantly altered. To obviate this, heavy magnetic inductions are allowed for in designing tramway generators, thus rendering it unnecessary to shift the brushes, and also avoiding sparking. It is the universal and best practice to use toothed armatures in tramway work.

As to the kind of field winding which should be adopted, it would seem from tests made on a large scale with separately excited, shunt-

Table 14.—Electric Tramway Generators.

Rated power.	Total weight of generator.	Diameter of shaft.	Armature. Diameter.	Armature. Weight.	Number of poles.	Revolutions per minute.	Commercial Efficiency. Full load.	Commercial Efficiency. Half load.	Commercial Efficiency. Quarter load.	Rated power.
Kilowatts.	Lbs. Tons.	Inches.	Inches.	Lbs. Tons.		Revs.	Per cent.	Per cent.	Per cent.	Kilowatts.
150	13,100 = 5·8	7 to 9	45	6,000 = 2·7	6	200	93½	92½	89	150
225	37,000 = 16·5	9 to 11½	59½	14,520 = 6·5	6	120	93⅝	93	89½	225
	34,300 = 15·3	9 to 11½	59½	13 920 = 6·2	6	150				
	21,000 = 9·4	9 to 10½	45	7,000 = 3·1	6	200				
300	60,400 = 27·0	14 to 16	59½	20,720 = 9 3	6	100	94	93	89½	300
	43,900 = 19 6	14 to 16	59½	16,650 = 7·5	6	150				
	39,100 = 17·4	14 to 16	59½	15 500 = 6 9	6	200				
400	74,250 = 33·1	15 to 18	72	31,480 = 14 0	8	80	94	93	89½	400
	71,440 = 31·9	15 to 18	72	30,580 = 13 6	8	100				
	64,300 = 28·8	15 to 18	72	28 740 = 12·8	8	120				
	59,700 = 26 6	14 to 16	65½	24 900 = 11·1	6	150				
500	87,150 = 38 9	16 to 18	88⅛	35,800 = 16 0	10	75	94	93	89½	500
	76,000 = 34 0	16 to 18	88⅛	32.000 = 14·3	10	90				
	71,300 = 31·8	16 to 18	88⅛	30,500 = 13·6	10	100				
	64,300 = 28·8	16 to 18	88⅛	27,100 = 12·1	10	125				
800	110,000 = 49 1	19 to 22	94½	49,440 = 22·1	10	80	94½	93⅜	90	800
	100,900 = 45·0	19 to 22	94½	45,520 = 20·3	10	100				
	94,400 = 42·2	19 to 22	94½	41,170 = 18·4	10	120				
1,300	158,930 = 71·0	24 to 27	126	69,910 = 31·2	12	80	95	94	90½	1,300
1,500	163,200 = 72·5	24 to 27	126	73,100 = 32·6	12	75	95	94	90½	1,500
250	40,000 = 17·8	12 to 14	60	15,000 = 6·7	...	100	...	...	...	250
400	60,000 = 26 8	16 to 19	75	25,000 = 11·2	...	90 to 100	...	...	...	400
500	90,000 = 40 2	18 to 21	80	30,000 = 13·4	...	90	...	...	...	500
800	125,000 = 55 8	21 to 23	90	40,000 = 17·8	...	80 to 90	...	...	...	800
1,200	195,000 = 87·1	23 to 25	115	65,000 = 29 0	...	80	...	...	...	1,200
1,500	240,000 = 107·0	24 to 27	130	70,000 = 31·3	...	75	...	...	...	1,500

that something goes wrong with the circuit breaker, and it will not immediately break the line when a short circuit occurs. It may therefore happen that an engine may be practically stopped dead, and enormous strains may thus be put on the fly-wheel. Moreover the moment the fly-wheel has stopped, the circuit breaker may happen to act, and the full power behind the piston may be applied to rotate the wheel, thereby again subjecting it to great strains. The utmost care has therefore to be taken in the design of fly-wheels. Accidents cause terrific havoc, and as far as the damage done is concerned are nearly as bad as boiler explosions, if not worse. In America the circumferential speeds allowed, even with cast-iron wheels, are much in excess of those to be met with in this country or

wound and compound-wound machines, that the best suited to tramway work from every point of view is the over-compounded generator. The usual pressure of current employed on trolley lines is 500 volts; and for this tension dynamos are so designed that the pressure between their terminals is 500 volts at no load, and is increased to 550 volts when the full load comes on. The over-compounding can be regulated up to 10 per cent. by varying a German silver shunt placed on the series coil.

Various curves were shown, for which the author is indebted to the British Thomson-Houston and Westinghouse Companies, giving the high efficiency of tramway generators with large variation of load.

SOME SUPERFICIAL NOTES ON SWISS POWER TRANSMISSION PLANTS, PRINCIPALLY POLYPHASE, AND A COMPARISON.*

By WILFRID L. SPENCE.

The combination of such excellent opportunities for observing Swiss practice in electrical transmission as were afforded by the exhibition at Geneva, and by the general opening of manufacturing and other works to engineers attending the Electrical Congress there in the early part of August last year, was one which the author deemed unlikely to again recur—at any rate for some considerable period—and one of which advantage should therefore be taken. Domestic arrangements made it impracticable to get away during the time of the Congress, but shortly after an offer on the part of the secretary of the Association of Students of the Institution of Electrical Engineers to accompany his party was gladly embraced, and this short paper is based on some of the notes then collected and subsequently embodied, in a condensed form, in a private report made to the Electric Construction Company, Limited, of Wolverhampton.

At the outset, the author thinks it desirable to state that the subject is approached from the point of view of a follower—afar off—but still with an open mind, of a past president of the Institution of Electrical Engineers, whose faith in the general applicability of the continuous current is well known, that the practical side of the question only is considered, that no claim is made to originality or particular fitness for the work, that his own personal opinions are given, and that the said opinions are not necessarily shared by any other individual known to him; and, finally, that as there was no thought of basing a paper upon the notes so made, they have been found lacking in the definiteness and precision which would appeal to a critical audience.

Knowing how Swiss inventors and manufacturers have taken a leading position in the practical development of alterating transmission plant, one was quite prepared to find this system very widely applied, and although among the twenty or so electric stations visited direct current equipments preponderated numerically, still it was somewhat of a surprise to find that the most striking feature was undoubtedly the very general adoption of alternating apparatus principally but not exclusively polyphase. ("Polyphase," as used throughout this paper, includes the two-phase system).

An expression of opinion, coming as this does from such able and experienced transmission engineers as the Swiss, is worthy of very careful consideration, and an attempt is here made to critically examine it in the light of a few picked examples.

The town lighting supply stations at Zurich and Neuchatel are typical cases of single-phase plant, the demand in the former place having outgrown the supply, it is eked out by a motor alternator (and not, as has been frequently stated, by a rectifier) and battery plant at the remote end of a feeder. At Neuchatel (if the author remembers aright) the alternators are specially arranged for running if desired at some future time as two-phase machines. Baden and Chèvres (City of Geneva Supply) are excellent examples of two-phase machinery, the distribution being purely two-phase alternating in the former and hybrid in the latter.

Three-phase plant is exemplified on a large scale for long distance transmission at Oerlikon and at the Zurich works of Messrs. Escher, Wyss & Co.

Single-phase transmission for power purposes is not used to any very considerable extent, and it will not be considered further, although it has been stated that the memorable experiments at Frankfort were originally intended to be with this class of machine, and only by the accident of having a three-phase generator at hand was a polyphase current employed.

Looking backward, the author believes the great impetus given to electric transmission by the brilliant success of these experiments is largely responsible for the preference ever since shown for alternate currents, not only three, but also two and single phase.

It was there demonstrated that exceedingly high line pressures could be commercially used, and that the alternate current alone was adapted for the step-up and step-down transformation necessary. This flexibility, of very real value in genuine long distance work, has since acted as a fetish, if the word may be used without offence, to conjure with, and it has apparently withdrawn attention from other methods believed to me more suitable in certain cases.

Along with the general adoption of two and three-phase currents for transmission has come the induction motor for power distribution, and it is difficult to say whether the compactness and simplicity of the motor, as a distributor, or the flexibility of the alternate current as a transmitter, has done most to forward the polyphase system, for which at different times and in various places the following advantages have been claimed:—

As to the generators. Polyphase dynamos have both a greater output and a greater efficiency than single phase machines of like size; they can be built without moving wire, and as a consequence the armature conductors are readily insulated for high voltage, armature reaction and pressure drop are slight under changes of load, so that but little regulation is necessary, and the same machines serve equally to supply current for lighting and power distribution.

As to the line:—A saving of copper amounting to about 25 per cent. is effected with three-phase current transmission as compared with a direct current line under equal effective pressure, the E.M.F. of transmission may, by the use of step-up and step-down transformers, be very greatly higher than that of the machinery at each end, the self induction of the line with three-phase current is small and the power factor correspondingly high.

* Paper read before Owen's College Engineering Society, Manchester.

As to the motors:—Polyphase induction motors have numerous advantages over any other type in being extremely simple in construction; they have neither commutators nor rubbing contacts, they can be started without resistance in the armature circuit, have good initial torque and regulating properties, and run like shunt-wound motors under similar conditions, they are small, highly efficient, require little attention, and are not liable to accidental damage.

And, generally, polyphase plant is of almost universal application, being admirably adapted for power purposes, and readily lending itself to efficient lighting from the same circuits.

These are some of the advantages which the writer had in mind, and was prepared to find in the several works where polyphase plant has been installed.

Now as to the extent to which they are realised in practice.

The works of the Maschinen Fabrik Oerlikon are largely driven by electrical power obtained from Hochfelden, distant nearly 1¼ miles. Three-phase current at 50 periods is generated at 86 volts, and after transformation to 13,000 volts is transmitted over a line consisting of four wires placed symetrically at the corner of a square of 19¾ inches side at a height of about 25 feet above the ground. The four wires, of which one is spare, in reserve, are carried on oil insulators, each is 4 mm. (0·158 inch) diameter, the material copper, and the resistance 31 ohms.

At Oerlikon the current, after being reduced in pressure to 190 volts, is distributed to induction motors, some of which are started by directly switching on the full pressure without resistance; other motors are furnished with slip rings, and have three-circuit starting resistances and switches to correspond.

The line loss is given at 7·5 per cent. of the initial H.T. voltage with 18 amperes per phase. This apparent load of 400 kw. furnished by two of the three 200 kw. hydro-electric generators running at full load corresponds to an actual net load of 310 kw., or the L.T. secondary at Oerlikon. The efficiency of the step-down transformers is not stated, but taking into account their size and the space occupied by the insulation necessary for 13,000 volts, it will probably not exceed, say, 95 per cent., and on this assumption the power factor appears to be slightly over 87 per cent, *i.e.*, ratio of apparent to true watts on the H.T. side at Oerlikon.

This is undoubtedly a high result, and it is attained by the extensive use made of synchronous machines, there being one such motor of 170 H.P. and another of 86 H.P., and in addition a steam driven alternator of 65 kw., over excited, and run in parallel with the power circuits, but doing little or no other work than acting as a phase controller. With such a long transmission line as 14 miles, it might be expected that there would be a very considerable amount of self induction to compensate, but this does not appear to be the case. The Maschinen Fabrik Oerlikon, to whom the author is greatly indebted for most of the hitherto unpublished details of this plant, as also for those relating to Messrs. Escher, Wyss & Co.'s installation, state that the "effect of induction on the line is not of importance and can be neglected," hence it would appear that the reduced factor is entirely due to the induction motors, some of which will always be running lightly loaded. It is noteworthy that the lighting and power circuits at Oerlikon are kept distinct, the bulk of the lamps being fed with continuous current. There may be a special reason for this as the hydro-electric power available is inadequate to run the whole works, auxiliary plant being regularly in use.

Just here it is interesting to make a rough calculation of what could be accomplished with a high tension continuous current over the same 14 miles line and using the same amount of copper. The basis of comparison, if not scientifically accurate, is an eminently practical one. The commercial transmission efficiency may be put thus:—

There are two 200 kw. generators running together fully loaded at Hochfelden, and affording a net load of 310 kw. on the secondary at Oerlikon.

For direct current transmission the three active line wires, having each a resistance of 31 ohms, will be combined into two of equal section, affording a complete circuit with a resistance of 19·1 ohms. The efficiency of two direct current transformers to give a combined output of 310 kw. on the secondary will be 93·5 per cent. so that 331·55 kw. must be delivered as high tension current.

This leaves 63·45 kw. as the line loss, corresponding to a current of 40·69 amperes to a primary generating pressure of 9,830 volts, to a line drop of 1,681 volts, and to a terminal E.M.F. of 8,149 volts. Present experience with high tension commutators goes to show that these pressures, while undesirable on a single machine, would be perfectly practicable if divided over two with the neutral connection earthed. This is a remarkable result, as the direct current primary pressure is fully 25 per cent. less than that actually used with the three-phase current.

Another instructive example of three-phase transmission was seen at the very fine and extensive Zurich works of Messrs. Escher, Wyss & Co.

The hydro-electric power house is situated at Zufikon, Bremgarton, distant about 12½ miles. There are four alternators of 224 kw., each driven by a 325 H.P. turbine, three-phase, 50 periods current is generated at 5,000 volts, and distributed in several directions, some 80 H.P. each going to Oerlikon and Wohlen, 60 kw. to Seebach, about 250 H.P. to a flour mill in Zurich, and about 400 kw. to Messrs. Escher, Wyss & Co.'s.

The Zurich line consists of two three-wire feeders, each conductor being of copper 7·7 mm. diameter, carried on double-shed porcelain insulators. The actual resistance of each wire is not known to the author, but it should be about 7·85 ohms. The conductors are symmetrically arranged three on each side of the post on the same number of cross arms, the distance, both vertical and horizontal, between contiguous wires being 17¾ inches.

The normal maximum load during the day time is about 400 kw., and the line loss 15 per cent. The load consists entirely of induc-

tion motors, many running more or less light, hence the power factor is only 73 per cent. As at Oerlikon, a synchronous motor is run continuously to compensate for the lagging current. In this case, however, the machine is a very large one, the three-phase armature being wound for 210 volts and 500 amperes at a speed of 750 revolutions, and it runs absolutely without external load, so as to secure the best regulation. The cost of this machine, with starting and synchronising gear, was about £480, or only £2 13s. per kilowatt, the speed being very high.

Here, also, the lighting is carried out with direct currents on a three-wire system, it being considered undesirable to have lamps on the motor circuits.

During summer the direct current lighting machines, aggregating 60 H.P., are driven by a three-phase motor, but in winter larger generators are required, and they are then run by a steam engine.

Again comparing with a direct current transmission. Three of the 7·7 mm. wires, each 7·85 ohms resistance when combined into two, will give a circuit resistance of 10·46 ohms. Allowing a total loss of 36·25 per cent. (corresponding to 15 per cent. line drop and a 75 per cent. power factor), it is found that with a primary generating pressure of 5,000 volts, a current of 173 amperes can be transmitted, giving a net power of 550 kilowatts, available on the high tension side at Zurich. This, of course, is very largely in excess of what is now actually obtained.

Two-phase transmission is not, so far as the author is aware, used in Switzerland over any long distances.

The Baden plant, installed by Messrs. Brown, Boveri & Co., who have very kindly revised the notes made at the time of the visit and have also furnished additional particulars, is an excellent example of two-phase apparatus. The generators are each composed of two electrically and magnetically independent single-phase alternators of what is known in this country as the Westinghouse type. In appearance they are almost identical with the two-phase generators subsequently exhibited by that company at Chicago. Each half machine is independently regulated, and the several alternators are paralleled in the power house. The frequency is 40 periods and the voltage only 1,000, the town feeders being barely a mile long, while Messrs. Brown, Boveri & Co.'s feeder is only $\frac{5}{8}$ths of a mile in length. In these works power is distributed at 115 volts by two-phase induction motors, driving principally short lengths of shafting. These motors, running up to 30 H.P., are started without resistance, but also without load by means of a slack belt gear.

Some smaller motors are started indifferently with or without load and without resistance, but all machines on public supply circuits must be provided either with a reducing transformer or preferably with slip rings and an appropriate starting resistance for the motor circuit. The latter disposition is the better one, as motors get under weigh with full load torque without taking more than the normal full load current.

The crane motors in these shops are all three-phase machines, running with the very low frequency of 13 periods per second. Current for them is furnished by slip rings on a two-pole direct current machine coupled to a two-phase induction motor, an arrangement, as will be seen, which removes from direct connection with the main circuits those motors most liable to frequent starts, stops, reversals, and variations of load; the main shop motors are, of course, run continuously during working hours.

The factory lights are principally tapped through special transformers on the town feeder, only a few being fed from their own power circuit.

Messrs. Brown, Boveri & Co., wish it to be borne in mind, in connection with this plant, that it was designed and laid down in 1892, a fact which will account for the divergence from modern practice in several of the details.

Perhaps the finest example of hydro-electric work in Switzerland, and certainly one of the most well considered, is the station at Chèvres, on the Rhone, supplying Geneva with two-phase 45 period current at 2,500 volts. The distance is not great, being about $3\frac{3}{4}$ miles, with an underground transmission line composed of four conductors, each 0·76 square inch in section.

The generators are simply two single-phase machines, of an inductor type, superposed on a vertical shaft. Each phase is regulated independently, and the alternators are to be paralleled in the power house.

The general arrangement of these dynamos is rather good, in that a considerable fly-wheel effect is obtained without undue weight on the shaft, and to the extent that there is no moving wire, it appears preferable to the Niagara design, which would not in any case have answered at Chèvres, because current suitable for lighting is a prime necessity. In passing, it may be noted that these machines give considerably less E.M.F. than was anticipated, and the difference is made up by boosters, "survolteurs." At the receiving end in Geneva there are several systems of distribution. One, a three-wire direct current supply at 2 × 110 volts, another an alternating network at the same pressure; a two-phase power circuit at 500 volts, also used for street lighting, and fourth, the trolley system, direct current at 500 to 550 volts. The first and last of these are fed through rotary converters, made by the Alioth Company, of Munchenstein, Bale, and it is noteworthy that notwithstanding the independent control over each phase at Chevres, the constancy of pressure at Geneva was greatly improved when these rotaries were started up.

Unfortunately, owing to the stoppage of the Chèvres plant since the close of the exhibition, the experience with these converters has not been very great, but Colonel Turrettini has informed the author that the working of the 2 × 110 volts lighting machines was not attended by any sparking, and they are believed to have been entirely satisfactory. These rotary converters are really very fine specimens of their class, and appeared to be thoroughly well designed and put together. A description of one of the two types, that with a Gramme armature, has been published in this country, but the larger machines with drum armatures have not previously been described. This latter form is preferred by the Alioth Company, who have very kindly placed the following particulars at the author's disposal.

The machine takes current at 360 volts alternating, on the slip rings from two 80 kw. transformers, one for each phase, and at a speed of 338 revolutions per minute, delivers 500 volts and 268 amperes at the commutator brushes. The armature is $34\frac{1}{4}$ inches diameter by $11\frac{1}{4}$ inches long. There are 320 slots and the same number of coils and commutator bars. The winding is of copper wire 2·5 m.m. diameter. The armature weighs 6,400 lbs., and carbon brushes are used.

The magnet yoke is of cast-iron, carrying 16 steel limbs and pole pieces, and absorbing 1,150 watts for excitation. The complete machine weighs 26,000 lbs. It is started by a regulating transformer of only 5 kw., used, however, as a reducer, the starting current being slightly in excess of that at full load, and the requisite E.M.F. only 12 volts or so.

The study of these converters is a most interesting one from several points of view, but particularly on account of their value as compensators for self-induction in generators and transmission lines, and incidentally because, while performing this function, they can be made to compensate for resistance drop on the direct current low tension distribution network.

It has been seen that the use of over-excited synchronous motors in the former capacity is much favoured in Switzerland at present, and if these are constructed to act as converters to direct current, it becomes practicable by variation in the strength of field to control the E.M.F. at the continuous current brushes. A strong field causes a rise and a weak field a fall of pressure at this point.

The leading and lagging currents respectively produced by these conditions may further be taken advantage of to produce a pronounced compounding effect. Mr. Steinmetz, the *Electrical Engineer*, New York, January 1st, 1897, has utilised this feature on a 14-mile transmission for street railway work between Oregon City and Portland in America. His arrangement is as follows:—

The generators are kept at constant excitation corresponding to 6,500 volts at no load, the line and transmission loss is about 10 per cent., and the converters have weak shunt excitation but a strong series field. In consequence, at light load their E.M.F. is low and a considerable lagging current flows over the line, the E.M.F. of self-induction is 90° behind the current, and as the current lags behind the E.M.F. of the generator, it results that the E.M.F. of self-induction is practically in opposition to the generator E.M.F., the impressed E.M.F. on the converters is reduced to that extent, and so brings down the pressure to 500 volts on the brushes of the rotary converter.

Conversely at full load the rotaries are much over-excited and their E.M.F. rises beyond the impressed E.M.F., the alternating current is then a leading one, and the E.M.F. of self-induction, being 90° behind the current, is nearly in phase with the generator E.M.F., so that at full load the voltage drop between generator and converter is greatly less, resistance drop being compensated by the rise due to self-induction and leading current, and as a result the voltage at the commutator brushes actually increases from 500 at no load to 550 at full load, instead of falling from 600 at no load to less than 500 at full load, as would otherwise be the case.

The method, while evidently very efficient from the point of view of regulation, is obviously no royal road to overcoming loss on the line.

Between light load with its lagging current and heavy load with its leading current, there is apparently only one point where the power factor becomes unity and then only are generators, line and converters working individually and collectively at their best, or at what should be their best. At all other times the losses must be considerably greater than correspond to the work done.

This particular method is not, so far as can be learned, in use in Switzerland at present. Any required variation on the direct current side is there obtainable either by regulation of the static transformers, which reduce the line pressure 2,500 volts to 360 volts for the slip rings, or by boosters on the primary. Other analogous arrangements are possible, and, in the author's opinion, preferable to compounding, which, however, is simple and automatic.

Reverting now for a moment to the claims already enumerated, which have been advanced for polyphase power transmission plant.

At Hochfelden (Oerlikon) the three phase dynamos comply with the claims; they are relatively small and inexpensive, are highly efficient, generate at a low pressure, which is transformed without difficulty to a very high one, and but for the inductive load would have a small pressure drop. The line, for reasons stated, does not show the 25 per cent. economy in copper which the three-phase system is supposed to effect over a direct current line.

The motors at Oerlikon are doubtless quite satisfactory; their use, however, entails a low power factor (reducing the available H.P. some 13 per cent. to 15 per cent,). This re-acts on the generators, and tends to cause a pressure drop of 15 per cent. or so, which is compensated at the cost of larger machines.

At Bremgarten (Escher, Wyss & Co.'s) the same remarks apply to the generators and to the line. The motors are not quite so simple as claimed, being in fair sizes started with resistance in the motor circuit. Their general use at all sorts of loads causes a very low power factor, not greater than 75 per cent.

At Baden (Messrs. Brown, Boveri & Co.) the two-phase alternators do not comply with any of the claims made for polyphase apparatus, but their construction does make it practicable to operate motors and lights together. The line has none of the advantages pertaining to polyphase circuits, the power and lighting feeders being distinct. The factory motors in medium sizes fulfil the claims, but are started with a slack belt gear.

At Chèvres (Geneva) the foregoing remarks apply to the alternators and to the transmission line.

With regard to lighting, it seems to be generally admitted that in connection with induction motors running under variable load, really good results cannot be obtained at all on the three-phase system. If lamps must be connected to the motor circuits, then a four-wire lighting distribution supplied, if possible, by a separate feeder, should be used.

With a two-phase system and single magnetic circuit generators the same remarks apply. A practicable result is obtained with independently controlled phases, but even then separate feeders are most desirable, and at the best one circuit, say the lighting, is closely regulated at the expense of the other, the power circuit.

In all cases where the transmission line is a long one, synchronous motors, or their equivalent, are essential at the receiving end.

It may be objected that in each of the three examples, Oerliken, Zurich, and Baden, the plant is not of the most modern design, and that with maturer experience the generators and transformers could be constructed with a smaller drop and the motors with smaller air space and less magnetising current. This may or may not be valid, but it remains that those who have had most experience consider that alternators with a potential drop of 4 to 5 per cent. at the lamps and about 15 per cent. at the motors are about as good as can be made.

Having said so much about the system generally, it is due to add that from the factory manager's point of view two and three-phase motors are perfectly satisfactory. Not too much need be made of starting under load and without resistance, because the same claim can be made for direct current shunt motors, and because in neither case is this allowed on public supply circuits.

The satisfaction arises more perhaps from the perfection of accessory details. It was noticed at Messrs. Brown, Boveri & Co.'s that small motor spindles were case hardened and ground true. The bearings, it goes without saying, are self-oiling. The worm reducing gear as turned out by the Maschinen Fabrik Oerlikon, and, doubtless, by others since, is a most excellently arranged mechanism. Its efficiency, which is remarkably high, is partly due to the ball thrust bearings, and partly, it is claimed, to high surface speed, but however arising, the success is undoubted, and more than sufficient to cover the multitude of sins attributable to high rotative speed. This gear is in almost universal use, not alone with induction motors, but also with direct current machines on overhead travellers, and one of the most pleasing features in all works visited was the favour with which the arrangement is regarded. It is almost unnecessary to add that hardly any one-motor cranes were seen.

The author's conclusions with regard to polyphase plant are as follows:—

(*a*) As exemplified by the two long distance transmissions named, three-phase plant involved very much higher line pressures than would be necessary with a practical direct current constant potential equipment under like conditions.

(*b*) Three-phase transmission at 10,000 volts, with power distribution by induction motors only, compares unfavourably with direct current plant at little more than one-half the voltage.

(*c*) For long distance transmission, a three-phase line has undoubted advantages over any other system, but to realise these it is essential that non- but synchronous or non-inductive consuming devices be used; induction motors have no place in work of this character.

(*d*) The best combination for really long distance transmission comprises three-phase generators (step-up transformers), line and step-down transformers, rotary converters excited for minimum current, a direct current distributing network and direct current motors. Ang regulation on the latter circuit is to be arranged so as not to cause phase displacement on the primary side. This is nearly, but not quite, the Niagara-Buffalo system.

(*e*) Where a line pressure of, say, 6,000 volts will give the necessary economy, three-phase apparatus is superfluous—a direct current plant, pure and simple, will be more advantageous.

(*f*) For short distance transmission at or below 2,000 volts, the use of a two or three-phase equipment is generally disadvantageous.

(*g*) English engineer electricians are to be congratulated on having viewed with some degree of scepticism the plunge made by their continental friends into polyphase work. This type of plant, which is undoubtedly doing good service in Switzerland, has no *raison d'être* in England. Its development is a result of really cheap water-power in some cases, and of supposedly cheap water-power in others.

It remains to notice another type of transmission which is peculiar to Switzerland, or at least to Swiss engineers: the extra high tension continuous constant current series system, developed by Mr. Thury, of Geneva. The general arrangement is well understood, and will not now be detailed.

The system is best suited for the transmission of power only, and for its distribution in moderately large units. The machines, generators and motors, alike are unquestionably very inefficient as compared with English constant potential dynamos of the same output; but on the other hand, is the fact that they work direct, without any transformation, on circuits of 15,000 volts or so. The motors have constant torque and a wide range of speed; the switchboards are extremely simple (because the connections are never opened), only short-circuited; there are no fuses, and the line is of uniform size throughout.

The disadvantages are obvious. Each machine has to be mounted entirely on insulators, and can only drive through a leather belt or insulating coupling. A wide wooden platform, also on insulators, is necessary round the machine for safety, and every motor requires an independent governor to control its speed. The system is consequently only practicable with main as distinguished from individual machine motors. For lighting purposes it is rather cumbrous, as low tension current can only be produced by the combination of a dynamo direct coupled to, but insulated from, a motor as above described.

The details of governors, automatic short-circuiting cut-outs, switchboards and lightning arresters are well worked out, and seem to give good satisfaction.

The system has found considerable acceptance in Italy and Switzerland in competition with polyphase apparatus, but particularly in situations where natural water-powers exist, but are too far separated or too inaccessible to be unified into one large scheme. These are picked up, so to speak, in series, an arrangement to which the plant readily lends itself.

In conclusion, the author wishes formally to acknowledge his indebtedness to Colonel Turrettini, President of the Administrative Council of Geneva, and to the Alioth Company of Bale, Messrs. Brown, Boveri & Co. of Baden, Messrs. Escher, Wyss & Co. of Zurich, and to the Maschinen Fabrik Oerlikon, all of whom very kindly responded to requests for information, and for confirmation of his notes.

ELECTRICAL MACHINERY AT THE WORKS OF MESSRS. SIR CHRISTOPHER FURNESS, WESTGARTH & CO., LIMITED, MIDDLESBROUGH.*

By Mr. WESTGARTH.

For my address, as president, I think it will be interesting if I give you a short description of the electrical driving plant at the works of my firm, Sir Christopher Furness, Westgarth & Co., Limited.

When we decided to extend our business, we acquired a site in Commercial Street which appeared to be advantageous, except that, unfortunately, it is divided into four parts by streets. Before we bought the site we considered carefully the question of motive power, because it became evident that it would be very expensive if a separate source of power had to be provided in each of the four sections of the works; but it was seen that the difficulty could be effectually overcome by the use of electricity. We made careful inquiries as to what had been done in the way of distributing power electrically, and finally decided to place a contract with our friends, Messrs. D. Selby Bigge & Co., of Newcastle, and to abide largely by their advice in working out the electrical details of the installation. It was necessary that the generating plant should be of the best possible description, and we decided to build a set of vertical triple expansion condensing engines, to work with steam at 200 lbs. pressure. The engines are of our ordinary vertical three crank type, having cylinders 14 inches, 23½ inches and 39 inches diameter × 24 inches stroke arranged to indicate 400 horse-power at 100 revolutions per minute. A Proell automatic expansion valve with high speed governor is fitted, and a heavy fly-wheel is placed at each end of the crank-shaft, each wheel driving one of the main dynamos. We decided to have a comparatively slow running engine, and to drive the dynamos with belts, because we thought that this arrangement would be the most serviceable for continuous work, and least likely to cause stoppage for repairs, which advantages we believed would more than balance the loss of power by the use of belts.

The air pump, which is on Edward's patent principle, and the feed pumps, are worked by levers from the centre engine, and a separate feed pumping engine is also fitted. The feed water passes through a filter, and then through one of our "Cleveland" live steam feed heaters before going to the boiler.

The boiler is of the ordinary marine type, 10 feet diameter × 10 feet long, fitted with Howden's system of forced draught, and the flues are carried under the boiler, so that additional heating surface is obtained, and all difficulty as to circulation when getting up steam is overcome.

The power station is so placed that the main machine shops in which the heaviest work is done can be driven by ropes directly from the engines, without the interposition of electricity. The rope driving wheels upon the main shaft are fitted with clutches, so that either set of ropes can be thrown out of gear without stopping the engines, therefore any line of shafting in the works, whether driven by ropes or electricity, can be stopped without affecting any other part of the machinery. In addition to the main engines, a vertical compound tandem engine, with 50 horse dynamo, is fitted in the engine room for night work, or for use in case of breakdown, all the dynamos being connected to the same switchboard.

In view of the use of high pressure boilers, it is very important to have a surface condenser, and as no source of condensing water was available except the town mains, we decided to use one of Ledward's patent evaporative condensers. This condenser gives a good vacuum, and the loss of water by evaporation is less than the amount of feed water.

The two main dynamos are of the ordinary continuous type, working in parallel, each capable of giving out 150 horse-power at 450 revolutions. The dynamos, as well as most of the motors, were made by the General Electric Company, of Leige, and so far have proved to be very satisfactory. Before the electrical work was put in hand, we considered the adoption of the polyphase system; but in view of certain difficulties as to patents (which I understand have since been got over) we were advised that it would be better to adopt the continuous current system. The voltage is 240, which was considered to be as high as it was safe to use, without risk of accident to workmen should they come in contact with the wires.

* Presidential address to the Cleveland Institute of Engineers. November, 1897.

A very important point to be determined was the number of motors which should be used, and we decided to fit separate motors only to a few of the larger machines, standing in such positions that driving belts would be an obstruction; otherwise the machinery is divided into groups of from four to a dozen, or so, according to size, each group being worked from a main shaft driven by its own motor. This arrangement has been found in practice to work very satisfactorily; the average power exerted by each motor driving a couple of machines being much less than would be required if each machine had a separate motor, in addition to which the first cost is materially reduced.

Another question was the arrangement of electric gear for the travelling cranes. After careful investigation we decided to adopt the use of one motor for each crane. The work is transmitted from the motor by a belt or ropes, which form an elastic medium connecting the machines, and is found to work very satisfactorily.

The works are lighted from the same dynamos, with separate system of wires from the switchboard. There are 52 arc lights and about 400 incandescent lamps on the works; the arc lamps being worked four in series, and the incandescent lamps in pairs. Arc lamps are also used for photographic purposes.

I regret that I am not able to give you any definite figures as to results, because our plant was just completed when the present strike of engineers commenced; but, so far as we can judge, the economy of fuel and working expenses is likely to be even greater than we anticipated. During the last few months, our average indicated horse-power has been 307, and the average consumption of fuel—costing 7s. 6d. per ton—has been 541 lbs. per hour; but the boiler, in addition to supplying steam for the engines, has supplied one, and sometimes two, steam hammers. The average weight of water evaporated has been 5,110 lbs. per hour, so that the evaporation has been 10·1 lbs. of water per pound of coal burned. The average cost of coal has been 1s. 9½d. per hour, and the average cost of water 1⅝d. per hour. During this time we have been employing about 480 men, and judging from what we were doing before the strike, although we have not any very accurate records, it appears that when we are employing about 800 men, the cost of fuel and water will really be very little more than the figures quoted above; these costs include the lighting as well as provision of power. I cannot give any reliable figures for the cost of maintenance, because the installation is hardly yet complete, but it is evidently going to be very light.

The total cost of the installation, including the motive power, has been about £10,000, and although this is a very large sum, the figures quoted above are quite sufficient to justify the outlay.

When the strike of engineers is concluded, and our works are in full operation, we shall be glad to show them to members of the Institution or to their friends.

THE ECONOMICAL GOVERNING OF STEAM ENGINES.

Writing in the *Engineering Magazine*, Mr. J. S. Raworth pays Watt the compliment of stating that he left the steam engine as nearly perfect as his environment allowed, even the governor being in principle but little departed from to-day. High speed has simply brought about a higher speed of governor apparatus, but the governor is still simply a pair of revolving weights of equal mass on opposite sides of a central spindle driven by the engine and counterbalanced as to centrifugal action by springs or gravity. In Watt's governor the gravity of the revolving masses was the sole counter-force to centrifugal action, but, the speed being low, there was not much centrifugality generated. Governors do not now command much attention mechanically, experience having shown that a governor must be so powerful that its own internal resistance and its external work shall be a negligible fraction of its total power. Governing has simply resolved itself of late into a thermo-dynamic question and arguments now turn upon whether governing should be effected by the old time throttle valve or the newer system of varying the cut-off.

The author acknowledges Watt as the father of the former system and, we think, rather erroneously attributes all the credit of the latter to Corliss, who, he says, achieved success through a clear appreciation of the principle above enunciated, *i.e.*, the principle of having a powerful governor. Possibly Mr. Raworth may mean that Corliss gave a great impetus to automatic variability, but he did not father it by any means. Mill engines in the North of England were at work fifty years ago which had automatic variable expansion gear which did not depend for its action upon any external work being done by the governor. The principle was applied to the old fashioned D slide, within which cut-off slides were worked by cams of rapid movement. The inventor of this movement altogether not only anticipated Corliss, but went one better in that he did not allow the governor to do any work at all, whereas the governor of Corliss was made to hold a kicking piece against a tendency to move it and so performed some work.

Willans' papers, the classic ones of 1889 and 1893, are in Mr. Raworth's estimation strong arguments against throttling, yet it is from a misunderstanding of Willans' work that advocates of throttling take their arguments. Willans' law as to steam consumption is in brief: with a fixed cut-off a certain quantity of steam is needed to drive an unloaded engine, and after that each unit of power is obtained at a constant rate. Thus full load is the most economical load and any reduction by throttling increases the consumption per horse-power, so that Willans' summing up was that "the problem was not how best to reduce the power but how to avoid reducing it." Willans could not, thinks our author, be expected to go too far out of his way to push automatic expansion, for he had not got to sell an engine that could be governed other than by throttling, but he was able to publish results of a 40-H.P. engine showing with various grades of expansion that if fitted with a really efficient cut-off it could be made to give results at reduced power, not so objectionable as Willans himself had shown they ought to be. The following figures were obtained, and they strike Mr. Raworth as peculiar, in that the best

Reference letter	M2	E3	O3	Z3
Steam chest pressure (absolute)	135·69	139·63	139·92	119·63
Mean pressure	46·89	31·67	25·23	18·72
Lbs. of steam used per I.H.P. hour	16·72	15·18	14·98	15·51
Fraction of full load ...	1·00	0·675	0·54	0·4

result (under O_3) is at the mean pressure of 25·23 lbs., which corresponds with the mean pressure in cotton mill engines which are sold by the degree of economy per I.H.P., though really the mean pressure of greatest commercial economy is higher, and would appear so if large engines could conveniently be put on a brake and the B.H.P. found.

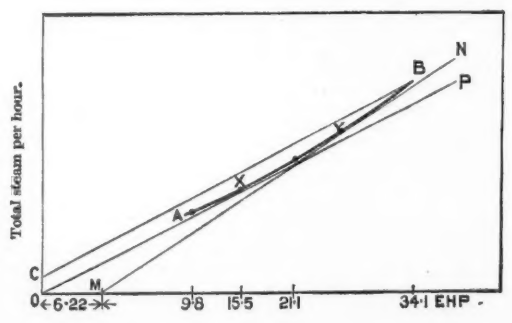
By coupling an engine to a dynamo whereby a joint efficiency of 81·9 per cent. is secured as between I.H.P. and E.H.P., Mr. Raworth obtains the following further figures, which show that the true

Reference letter	M2	E3	O3	Z3
Steam pressure (abs) ...	135·69	139·63	139·92	119·63
Mean pressure	46·89	31·67	25·23	18·72
M.P. to drive dynamo ...	7·24	7·24	7·24	7·24
M.P. available as electrical horse-power at terminals of dynamo	39·65	24·43	17·99	11·48
Steam per I.H.P. hour ...	16·72	15·18	14·98	15·51
Steam per E.H.P.	19·8	19·6	21·0	25·3
Net output per cent. ...	100·	61·3	45·25	28·9

economical mean pressure is 31·67 lbs. In the following diagram these results are shown.

The E.H.P. is marked on the base line, and total steam consumption is shown by ordinates to the curve, A B, the I.H.P. being E.H.P. + 6·22, the power required to drive the dynamo unloaded. The Willans line is C B.

O P is tangent to the curve, A B, and the point, X, of tangency is the point of least consumption per I.H.P. M N is also tangent to the curve A B and its point of tangency, Y, shows the lowest consumption per E.H.P., the diagram showing it possible to reduce power by expansion down to 65 per cent. for best load with a gain, and even to 45 per cent. with but little loss. The diagram or figures also prove



cotton mill engines to be too large and might be sold cheaper, and to be more economical if higher mean pressures were allowed. The truth is that neither makers nor users of engines have sufficiently realised that indicated horse-power is not what they should try to turn out. Brake horse-power is the only useful product, and in large engines the tendency is to lose much of the I.H.P. in the shaft bearings. The close coincidence of the curve, A B, and the line, M N, simply shows that wide load variation is possible with a small variation of steam consumption per effective horse-power. Now it is plain that for the steady load of a mill the ordinary full load should be chosen for the point, Y, but for electric traction a lower point ought to be taken so that on fuller loading, an engine should pass to a higher power through a more economical point of cut-off, and still have a margin for more power beyond at not too extravagant a rate of consumption. Electric *light* engines, on the other hand, require their normal load to be carried with a very high mean pressure in order that they may not run too wastefully at low powers. Electrical engineers are said to do all they can to avoid low mean pressures, but the Manchester School of Engineers seeks them and builds an engine of 1,000 H.P. in order to work it at 700 H.P. Mr. Raworth makes a point here, but he also misses something of the idea. Coal is cheap in the cotton mill district. An engine is expected to run with ease and certainty and not to tear out its inside on slight provocation. It is considered better commercial policy to pay a trifle more for fuel than to have a too light engine. Hence the purchase of engines a size or two too big so as to save the cost of break-down stoppages. Economy of fuel must then be sought, and is sought very keenly by every possible device. A better system

would be to buy a 1,000 H.P. engine, but to fit it with 700 H.P. cylinders, but the trouble would be that the engine maker would try to cut down his moving parts to suit the power. The steam user wants in fact stronger rods and framing, and he has got to buy the big cylinder as well. To use Mr. Raworth's own words "there are more things in this world than are visible to the naked eye." Altogether the article is a very instructive and useful contribution to practical steam literature.

PROCEEDINGS OF SOCIETIES.

Physical Society.

Ordinary Meeting, November 26th, 1897.

Mr. Shelford Bidwell, President, in the Chair.

Mr. Rollo Appleyard read a paper on The Failure of German Silver and Platinoid Wires.

The mechanical defectiveness and the consequent electrical instability of alloys used for electrical wires may be discussed from two points of view:—(1) As to the constitution and metallurgy of the alloy. (2) With regard to the subsequent treatment and environment of the wire. In stating the case, the author gives instances of the failure of German silver and platinoid wire that have occurred among several thousands of resistance coils distributed over widely different latitudes. In periods of time, varying from six weeks to several years after manufacture, the wire on some of the bobbins became brittle and broke, not only on the outer layers, but also within the coils. The towns where the faults appeared are all within the tropics, and included nearly within the isotherm of 25° C. Other coils, of nominally the same material, manufacture, and environment have retained their original good condition. It follows that metallurgical differences exist between different samples of the same nominal quality of alloy. Examples are given to prove that failure sometimes occurs with platinoid through which no electricity has passed. Provided that the wire is good, the effect of environment is almost insignificant, *i.e.*, the question is one of metallurgy rather than of instrument making.

The author introduces a distinction in regard to brittleness. He discriminates between "primary" and "secondary" brittleness. "Primary" brittleness is characteristic of certain alloys (for instance, of gold-lead, or of gold-bismuth) from the moment of their solidification. But the brittleness of German silver and of platinoid is of a different order, it is a subsequent phenomenon. "Primary" brittleness is thus an accident of birth, and "secondary" brittleness is a disease that develops with age and circumstance. The fracture of bad specimens of German silver and platinoid shows patches of dark metal, crevices, and fissures. It may be supposed that during the process of cooling "liquation" occurs—the metals that first solidify, rejecting yet molten portions, as ice rejects foreign matter. Consequently, the strength of the final alloy varies from point to point of its mass, and in passing afterwards through the die, the weaker portions give way, and the general structure is loosened. Moisture can then intrude through the capillary channels. At all fissures and crevices the electric current produces undue heating; this accounts for the failure of resistance coils on arc light and other circuits. As regards the protection of coils against moisture paraffin wax is of no use whatever; it is highly absorbent. Shellac varnish is greatly to be preferred. Ebonite does not seem to have any deteriorating effect, but it may be well to keep the alloys out of actual contact with it. In conclusion, Mr. Appleyard expressed a hope that British metallurgists would give electrical alloys special consideration. Already, British cable manufacturers are importing thousands of tons annually of sheathing wire from Germany; this is sufficiently to be regretted. He had good reason to know that instrument makers were beginning to get the wire for their resistance coils also from Germany. He had not enough experience of manganin to say whether that material would stand rough service in the tropics.

Prof. Ayrton said the paper had raised the extremely interesting question of the permanency of metals used for resistance coils. Some time ago he had immersed bare platinoid wires in running water in metal tanks, and the wires all broke into short pieces. He thought at the time this might be due to electrolysis. On another occasion he had found that by raising the temperature of platinoid to a dull red heat in the air by an electric current, any acquired faults in the wire were corrected, and the original resistance and flexibility were restored. Even when such metals are in good condition, the resistance-temperature curve does not return upon itself; it encloses a loop, indicating two distinct values for resistance at each temperature. He had been told by Dr. Muirhead that coils intended for hot climates should be enclosed in air-tight metal cases. English manufacturers were still dubious in regard to manganin. In 1892 he had 20 coils of this material, each of a thousand ohms; the wire was silk covered. There were 2,000 volts between the terminals. Their resistance had certainly not changed by 1 in 1,000, although there was some amount of vagueness regarding the fifth figure, which might be due to molecular variation, for they were heated more than was good for resistance coils. He confessed that this manganin had come from Germany.

Dr. S. P. Thompson mentioned an alloy that was proposed in Germany under the name of "Constantine." He would like to know whether any information could be obtained as to the employment of cast-iron wire. It was a metal that in some respects commended itself. He had observed the failure of some German silver coils but he had generally attributed it to rough handling.

Mr. W. Watson referred to the recent work done at the Reichsanstalt with regard to German silver and platinoid. It was there found that all alloys containing zinc were liable to erratic change of resistance, and were unsuitable for standard coils. Moreover, even the slight amount of zinc introduced into manganin during soldering with soft solder robbed that alloy of its constancy. Silver solder, containing 75 per cent. of silver, should be employed for manganin. If Prof. Ayrton's coils were soldered with soft solder that was sufficient to account for the change in the fifth figure. Shellac varnish was undoubtedly the best protection for coils. Absolute alcohol should be used as the solvent, and the coils should afterwards be heated for some hours at 140° C. If a heating current was passed through German silver or platinoid coils immersed in water, the general result was to produce brittleness. Mr. Watson then described a thermostat which he had contrived for drying the coils after applying the shellac varnish. A hot-air oven contains a thermometer with a platinum contact at the 140° mark, and an 8 C.P. lamp. The thermometer is in circuit with a relay actuating a mercury key for the 8 C.P. lamp. The key consists of two mercury cups, and a corresponding U-piece of copper, inverted, one limb to each cup. It is important to keep the heating circuit always made; for this purpose a 32 C.P. lamp is permanently connected between the two cups.

Prof. Perry then read a note on a question in Thermo-Dynamics, arising from correspondence that had taken place between himself, Prof. Ramsay, and Mr. Rose-Innes, with regard to a paper in the Roy. Soc. *Trans.*

Mr. Rose-Innes replied.

The President proposed a vote of thanks to the authors, and the meeting adjourned until December 10th.

SIEMENS & HALSKE.

The famous firm of Siemens & Halske has just been celebrating the 50th year of its existence, and in connection with this event a historical retrospect of the acts of these pioneers of modern electrical engineering has been published by Dr. W. Howe.

In 1847, 50 years ago, Werner Siemens wrote to his brother William Siemens, in England, "I have now definitely agreed with the mechanic Halske to start a factory, and we hope in six weeks to make a start. Halske, who is to have an equal share in the business with myself, will have charge of the workshop, while I shall have charge of the laying of telegraph lines, making of contracts, &c. For the present our business will consist of the manufacture of telegraphic apparatus, signal bells for railways, and wires insulated with gutta-percha. After a long search we have found a suitable workshop. I occupy the ground floor, the workshop is on the first floor, and Halske occupies the second floor; the rent of the whole being £45." On October 12th the workshop was started with three lathes, and in December of the same year 10 workmen were fully employed.

In 1897 this small firm has developed into the largest and most comprehensive electrical manufacturing business in Europe. The small Berlin workshop was replaced in 1852 by the present great manufacturing and business establishment in Markgrafenstrasse, in which, at the present date, 1,800 workmen are employed; one department devoted to electric traction employing 930 men. At Charlottenburg, works employing 3,300 men have been built for the manufacture of dynamos, cables, and other heavy electrical plant; and, at the same place, an additional factory for the production of arc lamp carbons has been recently erected. In 1855 a factory was started at St. Petersburg, which now gives employment to 1,000 workmen; in 1858 the London business was started; and in 1883 a factory was started at Vienna with 50 men, in which 1,900 workmen now find employment.

This thousand-fold development in the amount of their business is not the only thing for which this great firm is remarkable; for if we are to accept without demur all the statements in Dr. Howe's pamphlet, the firm, and more especially its distinguished head, Dr. Werner Siemens, has initiated nearly all the most important advances which have created the profession of the electrical engineer. As Dr. Howe puts it, "without doing injustice to others, the history of the firm of Siemens and Halske would form an almost complete history of the evolution of modern electrical engineering." Some of the "others" who read Dr. Howe's pamphlet will not, we fear, be inclined to agree with this eulogistic dictum.

Werner Siemens' attention was first drawn to electricity by the discovery made by Jacobi in 1840 of the electro-deposition of copper. In 1841 he, himself, invented a new process of electro-plating with gold and silver, and, shortly after, devised a method of measuring velocities by the electric spark, and applied the self-breaking principle to the Wheatstone A B C instrument. In 1846 he received from his brother William in England a sample of gutta-percha, a material which had just been introduced into the European market. He soon discovered the value of this material as an insulator for underground telegraph wires, and constructed a screw press for coating the wires on a model which is in use for this purpose at the present day.

Siemens was at this time an officer in the Prussian army, but his interest in the applications of electricity had become so great that he determined to abandon the military career, and start an electrical engineering works in partnership with Halske, the mechanic who had assisted him in some of his early experiments. This scheme was carried out in 1847 as we have already stated. The new firm came on the scene at the nick of time; the Governments of Europe were waking up to the importance of the electrical telegraph, and orders came in rapidly from the Prussian and Russian Governments for the

construction of underground and overhead telegraph lines. The outcome of the Russian business was the establishment of the separate factory at St. Petersburg in 1855, under the management of Carl Siemens. In 1858 William Siemens started the London works which were considerably enlarged in 1863 when the large workshops were erected at Charlton.

The end of 1866 and the beginning of 1867 will ever be memorable for the invention of the self-exciting dynamo. The idea appears to have been suggested to Werner Siemens by Wilde's experiments in England. He writes to his brother William on the 4th December describing the principle of the dynamo, and constructed his first dynamo shortly after Christmas. The first publication of his invention was made to the Berlin Academy on the 17th January, 1867. No mention is made by Dr. Howe of the claims of others to this epoch making invention; for instance, the fact is ignored that S. A. Varley's specification was filed early in December, and that this English electrician had constructed a self-exciting dynamo in the previous August. This is not the only instance in which the claims to priority of English inventors have been ignored. In the same year in which the dynamo was invented, the firm of Siemens and Halske was joined by von Hefner Alteneck, one of the many distinguished men with which Siemens surrounded himself, and who was destined 7 years afterwards to make the next great advance in dynamo construction by the invention of the drum armature.

The starting point of modern electrical engineering was the Paris Exhibition of 1881. "Electricity," as Werner Siemens said in his address to the Electrotechnical Society of Berlin, "had ceased to be employed only for delicate work, such as controlling and directing, releasing and shutting off power; it has become, thanks to the advances in dynamo construction, one of the great working powers." Applications of electricity in its new function as a great working power, or transmitter of energy, issued rapidly from the workshops of Messrs. Siemens & Halske. The first electric lift was erected at Mannheim in 1880; the first electric railway was built at Lichterfelde in 1882; the first application of electricity to underground haulage in mines was made at Zaukerode and Neu Stassfurt in 1889; the first conduit electric street railway was built at Buda Pesth in 1890 (ignoring, as Dr. Howe does, Holroyd Smith's Blackpool line of 1882-83); the first rack railway with shunt motor was built at Barmen in 1894; and the first sub-pavement railway was built at Buda Pesth in 1896.

Halske, the less famous member of the firm, left it in 1868. The immediate cause appears to have been the great increase of the business of the firm which followed their undertaking of the construction of the Indo-European overland telegraph line from London to Calcutta, through Germany, Russia and Persia. In 1863 he withdrew from the London firm, which, at that time, had suffered considerably through the failure of the first submarine cable laid from Carthagena to Oran. The London business was then taken over by the three Siemens brothers, Werner, William and Carl, and was converted into a kind of family joint stock company in 1880, first under the management of Herr Löffler, and later of Alexander Siemens. Sir William Siemens died in 1883, and nine years later his still more celebrated brother, Dr. Werner Siemens. In this short sketch much of the important work done by the firm has necessarily been admitted. Fuller information may be obtained by those who wish it from Dr. Howe's retrospect.

CENTRAL STATION ELECTRIC COAL-MINING PLANT IN PENNSYLVANIA, U.S.A.*

By Mr. W. S. GRESLEY, Assoc.M.Inst.C.E.

The author described and illustrated the application, to a somewhat scattered group of mines, of the electrical transmission of power for haulage, drainage, ventilation, coal-cutting, &c., from a central station conveniently placed on the property. The extent of the mining operations had become such that mule haulage on main roads, furnace ventilation, steam, mule and hand pumping, siphoning and bailing of water, pick-mining, &c., were too expensive and unsatisfactory; and electricity had been decided upon as the most reliable and practicable form of power for general use throughout the property, which was about 5,800 acres in extent. Direct current, at a pressure of 500 volts, was employed, with the generating station situated about the middle of the mines. There were four 100-kilowatt generators, each belted to a 150-H.P. non-condensing high speed engine, and six 125-H.P. tubular boilers. The generators were joined in parallel. Five collieries were equipped with electric motors; in three the coal was hauled about 1 mile by a 50-H.P. locomotive working on the overhead trolley system; each mine had a triplex 200-gallon pump, fitted with a motor developing 5 H.P. to 10 H.P.; three of the pits were equipped with Capell fans, driven from belted motors of 25 H.P. to 50 H.P., and in two of the pits most of the coal was undermined by Jeffrey electric chain machines. Outside the mines the circuits were of bare copper wire, carried on stout poles, but the river was crossed by five submarine heavily armoured cables attached to pole lines on each bank. In the mines most of the wires were bare, and were hung along the walls or fixed to blocks or pins on the roof. The locomotive hauled about 1,100 tons of coal each per 10-hour day. They displaced about 39 mules with their drivers. The three locomotives were similar, each weighing 10 tons, and all their electrical apparatus was interchangeable. Their speed was 8 miles per hour. Particulars of the comparative advantages of haulage by electric motors and by mules were set forth in a Table, and sections, plans, &c., of the roads were given. The coal seam, the "Pittsburg bed," was about 5½ feet thick and lay fairly level; each mining machine undercut about 120 tons per day. The "room and pillar" system of working was employed. Eleven coal-cutting machines were in use; each absorbed about 15 H.P., and cut about 2½ tons in 4½ minutes; but the actual cutting time was only 6 hours out of every 24, the rest being lost in moving the machines from place to place, changing the bits, and between shifts. Machine mining required about one-third fewer miners than pick work. About 70 per cent. of the output was cut by machines. The electric pumping consisted almost entirely of keeping water out of numerous branches, or dipping sections of each mine, so that the sections consisted of long lengths of pipe fitted with valves, in charge of which men were employed to regulate and keep down the water as required. Particulars of the ventilating fans, &c., were shown in tabular form, for comparison with which, data, relative to the old furnaces, as well as to one of the fans when run by a steam engine, were given. All the fans were belted direct to pulleys on the armature shaft, which ran at 625 revolutions per minute, the speed of the fans varying according to the requirements of the collieries. All were at present running light. The fans were of the Capell exhaust type, set up in brick races with iron covers and chimneys. The entire plant was in charge of an electrician, with a staff of machinists. The machinery had been started in July, 1895. The daily coal consumption was about 17 tons—mostly slack and fine coal, produced in the under-cutting. Load curves under different conditions of working were given, and indicated in a marked manner the extremely variable and sudden changes of load upon the dynamos, and showed what a large reserve of power must be provided for to successfully work such a plant. The average day load was about 42 per cent. of full load, the night load being only about half the day load. The total length of circuits already in use was about 40 miles, and the most distant motor from the power house as yet in operation was a 30 H.P. fan motor, situated nearly 3½ miles from the central station. The success of the plant had been such that additional coal-cutters, &c., were now contemplated. One man had been killed from shock received through the trolley wire, but he was not concerned with working the locomotive or with the wiring. The installation had cost about £23 10s. per horse-power developed by the engines. Repairs and working cost about £5 per H.P. per year, or about 1½d. per ton of coal produced.

* Abstract of a paper read before the Institution of Civil Engineers on November 23rd.

THE ENGINEERS' DISPUTE.

The much talked of Conference has begun to sit, and has sat in private, so that no full accounts have come out. The first item for discussion was that of interference. After the late numerous disclaimers of all desire to interfere, we quite thought that when there was planked down the first item, as follows:—

"1. The Federated Employers, while disavowing any intention of interfering with the legitimate action of trade unions, will admit no interference with the management of their business. The trade unions on their part, while maintaining their right of combination, disavow any intention of interfering with the management of the business of the employers,"

Mr. Barnes would have stood up and smiled pleasantly to Colonel Dyer, and said I think we are all agreed to this clause; let us put it to the vote and pass it forthwith, and proceed. But we cannot learn that anything of the sort occurred, whereat we are mightily surprised. All day was spent in discussing an item that Mr. Barnes has practically assured us he knows nothing of. Can it be that for the first time in his life Mr. Barnes has learned that gross interference, even to the extent of bodily injury, has been long a common practice. It may be so. Howbeit Mr. Barnes had not absorbed the lot by the time of rising, and the same item continued to be discussed on Thursday and yet again on Friday, when a conclusion was reached. The representatives of the men accepted the employers' proposals subject to a ballot of their members.

This may be taken as conclusive, we fancy. The men will ballot probably unanimously, and the *amour propre* of their leaders will be saved. It is a little curious how the men are to be considered. Pity Messrs. Barnes & Co. did not allow the men a bit more voice before ordering this silly, fatuous strike. The Unions fought hard for the right to interfere, and not until Friday did they submit. What they accepted was No. 5 proposal. It reads as follows:—

"The Federated Employers, while disavowing any intention of interfering with the proper functions of Trades Unions, will admit no interference with the management of their business, and reserve to themselves the right to introduce into any federated workshop, at the option of the employer concerned, any condition of labour under which any members of Trades Unions here represented were working at the commencement of the dispute in any of the workshops of the Federated Employers.

"It is further agreed that the discussion and mutual settlement of matters of detail which illustrate the above general principle shall be at once proceeded with at this Conference.

"Nothing in the foregoing shall be construed as applying to the normal hours of work, or to general rises and falls of wages.

"Clause 4, Sub-section B, of the basis of conference provides for the discussion and settlement of the best means of avoiding, as far as possible, future disputes."

Thus, while disclaiming all desire to interfere, three days have been

spent in fighting for it, and while denying the facts as to interference published by the employers, we find that seekers after truth in the matter are discovering in the reports of the A.S.E. itself the strongest confirmation. Thus in January, 1897, a report signed George N. Barnes states:—"Perhaps the most striking concession of the month is that at Earles', of Hull, where our members, after a strike maintained with a pertinacity beyond all praise, have forced recognition of the principle that machines which supersede hand-skilled labour should be manipulated by skilled or full paid men."

And again in March appears this.—"Our Belfast members, adhering to the custom of their district, claim this machine for a turner, and the advent of the unqualified man was the signal for an almost instant cessation of work."

In May a district delegate named Ratcliffe wrote:—"The vested interests—equally with employers—of workmen in a trade by probationary servitude are apparently to be set at naught . . . . This right of 'discretion' by employers is acknowledged by no trade, and surely cannot be by ours."

The one fact apparent at the Conference is stated by the *Times* representative at the risk of hurting the feelings of Mr. Barnes, that the delegates thereto are mostly representative of the old unionism, and not of the new. The A.S.E. executive has, in fact, been given the go-bye, and men banished from London by the new unionists have been put upon the Conference. In the mean time there is every evidence that the strike was dying out. Men have tired of paying levies for the sake of maintaining their connection with a society that has no pension fund remaining available. Men cannot worsen themselves by leaving the union, to such a pass have the new men brought this once wealthy society; and as there is a rumour abroad that huge levies will be made to put a new fund together at once, the number of secessions increases rapidly, and every week sees fewer men to levy upon. We think it a pity that the Conference is not fully reported. We may suppose it is reported for future publication, but at present the discussions are unknown.

Mr. Little, of the New Conveyor Company, has been compelled to buy machine tools in Germany, and he invites Messrs. Barnes, Burn, and Mann, or any member of the A.S.E., to come and inspect them. Mr. Little, who writes to the *Engineer*, asks all such of the A.S.E. who like Judas carried the bag, to go and do likewise in another respect as some reparation for the evil they have done. We think now that a settlement is approaching, hard words had better cease. It is difficult, perhaps, to refrain where one feels strongly, but let us hope better times are coming. The conference was resumed on Tuesday when details connected with the question of interference were understood to be discussed. *Engineering* sees less cause for cheerfulness in the composition of the men's half of the Conference, intimating that probably the A.S.E. is merely lying low for a time.

The latest news to hand seems to indicate that there is a little friction in regard to the very distinct arrangement come to as a result of the first three days of conference. This agreement was virtually a surrender of the whole claim of interference. Mr. Barnes seems now to be disposed to look on the arrangement as merely provisional. We think he is making a great mistake. To abolish interference means the victory of English trade over our cute American and plodding German competitors. To abolish interference means more work for Mr. Barnes' supporters. Can he possibly be so short-sighted as not to see this, or is he determined to retreat, like the cuttlefish, in a cloud of merely hollow resistance. It is like posing as the game chicken of unionism to the last. We think Mr. Sellicks and others will hardly back him out in this latest move. As it stands Mr. Barnes is setting himself against the opinion not only of the employers only, but of trades unionists also, or the main body of them.

PARLIAMENTARY POWERS.

In addition to the large number of notifications of applications for electric lighting tramway powers which have already appeared in the *London Gazette*, there are the following further notices in last Friday's issue of that journal. It would therefore seem that there is plenty of work ahead, though these schemes at the present moment only exist on paper. It is reasonable to expect that the majority of them will be carried into effect:—Melton Mowbray (electric lighting powers for the Melton Mowbray Electric Light Company); Norwich (electric lighting extension powers to the Norwich Electricity Company); Buxton (electric lighting powers to the Buxton District Electric Light and Power Company); Chelmsford (electric lighting powers to the Chelmsford Electric Lighting Company for the parishes of Writtle, Great Baddow, Broomfield, Springfield, and Widford); City and South London Railway Company (various powers *re* sidings at Clapham, extension of time, power to sell part of the existing undertaking to the City and Brixton Railway Company); Wigan Corporation (tramway powers); Holborn district (electric lighting powers to the Charing Cross and Strand Electricity Supply Corporation); Bethnal Green, Poplar and Whitechapel (electric lighting powers to the County of London and Brush Company); Westgate-on-Sea (electric lighting powers for District Council); Bridgwater (electric lighting powers for the Corporation); Warrington (electric lighting powers for the Corporation); Smethwick (electric lighting powers for the District Council); Highgate and Finchley (tramway powers); Midland Electric Corporation for Power Distribution (supply of electricity for power purposes in Staffordshire and Worcestershire); Leigh-on-Sea (electric lighting powers for District Council); Bermondsey, Rotherhithe, Greenwich, and Lewisham (electric lighting powers for the County of London and Brush Company); Holborn and St. Giles (electric lighting powers to the County of London and Brush Company); Linthwaite (tramway powers of the District Council); St. Giles (electric lighting powers to the Charing Cross and Strand Electricity Supply Corporation); Blackburn Corporation (powers *re* transference of tramways to Corporation, construction of new lines, &c.); West Bromwich (electric lighting powers to Corporation); Bristol (powers to the Bristol Tramways and Carriage Company for the construction of new tramways, and various provisions *re* same); Middlesbrough (electric lighting powers for the Corporation); King's Norton (electric lighting powers for the District Council); Marylebone (powers to the Marylebone Electric Supply Company for electric lighting); London (the Corporation applies for various powers, including the construction of railways, tramways at Deptford, their operation by electrical power, and particulars of the lines are given); Oldbury (electric lighting powers to the District Council); Bolton, Turton, and Westhoughton (extension of boundaries and of the electric lighting area); Hastings and St. Leonard's (tramway powers to a company to be formed); Lowestoft (electric lighting powers to the Corporation); Penarth (electric lighting powers to the Penarth Electric Lighting Company); St. Annes-on-the-Sea (electric lighting powers to the District Council); Ilfracombe (District Council electric lighting); St. Marylebone (electric lighting powers for the County of London and Brush Company); Kingswinford (District Council electric lighting); Blackpool, St. Anne's and Lytham Tramways (powers to the tramways company for extensions, &c.); New Cross and Waterloo (underground railway powers to a company, provisions *re* electric or cable power, &c.); Frodingham (powers to form a company for supply of gas, electric lighting powers included); Whiston (District Council electric lighting powers); North Staffordshire (powers to the tramways company to construct and work certain lines, use and supply of electrical energy, &c.); Eccleshill (tramway powers for the District Council); Llandudno (powers for the District Council to construct and work tramways, electrical or other motive power, &c.); Bristol Tramways (powers to the Bristol Tramways and Carriage Company *re* employment of electrical power, &c.); Devonport, Plymouth, and Stoke (powers to form a company to construct and work tramways, motive-power, &c.); Preston (powers for electric lighting extensions, National Electric Supply Company, Limited); Darlington (Corporation electric lighting powers); Ramsgate (electric lighting powers for the Electric Supply Corporation); Ryde (electric lighting powers for the Ryde Electric Light and Power Company); Peterborough (electric lighting powers, Peterborough Electric Light and Power Company); Weymouth and Melcombe Regis (electric lighting powers, Weymouth Electric Light and Power Company); Huyton-with-Roby (District Council, electric lighting powers).

Tuesday's *London Gazette* contained the following:—Burslem (electric lighting powers for the Corporation); Carlisle (power to form a company to construct tramways, use mechanical power, purchase electric power from other companies, &c.); Bolton Corporation (electric lighting powers for the suburbs); Waterloo-with-Seaforth (powers to District Council to construct tramways to be worked by animal or mechanical power, enter into agreements, &c.); Great Crosby (powers to District Council to construct tramways, animal or mechanical power; Royal Leamington Spa Corporation (electric lighting powers); Margam District Council (electric lighting); Stoke-upon-Trent Corporation (electric lighting); Shrewsbury Corporation (electric lighting); Lewisham Board of Works (electric lighting).

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1897.

[*Compiled expressly for this journal by* W. P. Thompson & Co., *Electrical Patent Agents*, 322, *High Holborn, London, W.C., to whom all inquiries should be addressed.*]

26,640. "Improvements in electrical resistance apparatus." F. Hughes. Dated November 15th. (*Complete.*)

26,646. "Improvements in wattmeters and in the means for damping in same and in other apparatus. The British Thomson-Houston Company, Ltd., and Frank Holden. Dated November 15th.

26,647. "Improvements in or relating to alternating electric current meters." C. O. Bastian and F. M. Staunton. Dated November 15th.

26,656. "Improvements in and relating to electric accumulator plates." P. F. Ribbe. Dated November 15th. (*Complete.*)

26,657. "An improved device for guiding the carbons in electric arc lamps." R. W. L. Holsten and The Elektrische Bogenlampenfabrik Naeck and Holsten Gesellschaft Mit Beschrankter Haftung. Dated November 15th. (*Complete.*)

26,659. "An improved automatic cut-out or short-circuiting device for electric arc lamps." R. W. L. Holsten and The Elektrische Bogenlampenfabrik Naeck and Holsten Gesellschaft Mit Beschrankter Haftung. Dated November 15th. (*Complete.*)

26,660. "An improved electric arc lamp." R. W. L. Holsten and The Elektrische Bogenlampenfabrik Naeck and Holsten Gesellschaft Mit Beschrankter Haftung. Dated November 15th. (*Complete.*)

26,672. "Improvements in or relating to electrically controlled operating devices for railways." P. Leschinsky. Dated November 15th.

26,680. "Improvements in electric accumulators or storage batteries." A. Tribelhorn. Dated November 15th.

26,682. "Improvements in electro-medical and exercising apparatus." W. A. Webb. Dated November 15th. (Date applied for under Patents, &c., Act, 1883, Sec. 103, June 2nd, 1897, being date of application in United States.) (*Complete.*)

26,694. "A hot air engine driven by electrically heated air." H. A. Fenn and H. T. P. Simpson. Dated November 16th.

26,709. "Improvements in portable electric guns." A. D. Manlove. Dated November 16th.

26,727. "Improvements in electric brakes for cars." O. J. Menzies and J. A. Bell. Dated November 16th. (*Complete.*)

26,729. "Improvements in alternating current electric motors." W. L. Wise. (Alexander James Churchward, United States.) Dated November 16th. (*Complete.*)

26,732. "Improvements in or relating to systems of electrical distribution." L. Andrews. Dated November 16th.

26,733. "Improvements in magnetic cut-out apparatus." L. Andrews. Dated November 16th.

26,734. "The application of one handle in relation to electrical switches." Wm. Hughes. Dated November 16th.

26,752. "Improvements in flexible conduits for electrical conductors. E. T. Greenfield. Dated November 16th. (*Complete.*)

26,762. "An improvement in the bulbs of electric incandescent lamps." F. W. Few. Dated November 16th.

26,799. "New or improved means and apparatus for utilising part of the heat of gas and other heating stoves for the purpose of generating electric currents." H. J. Dowsing. Dated November 16th.

26,803. "Improvements in the bulbs or envelopes of electric glow lamps." G. W. Smiley. (F. W. Dunlap, Germany.) Dated November 16th.

26,827. "Improvements in electric arc lamps of the enclosed type." A. L. Davis. Dated November 17th.

26,880. "Improvements in or relating to electrical furnaces specially applicable for the production of calcium carbide." G. W. B. Crees, W. L. Durban and J. Gore. Dated November 17th.

26,881. "Improvements in and relating to electrical furnaces specially applicable for the production of calcium carbide." G. W. B. Cress, W. L. Durban and J. Gore. Dated November 17th.

26,918. "Improvements in or connected with electrically driven vehicles." J. Hopkinson. Dated November 17th.

26,919. "Improvements in or relating to the application of electrodes in electrolytic processes." O. C. Strecker and H. H. Strecker. Dated November 17th.

26,921. "Improved process for preparing insoluble or hardly soluble salts from metallic anodes by electrolysis of aqueous solutions containing two salts." O. C. Strecker and H. H. Strecker. Dated November 17th. (*Complete.*)

26,923. "Improvements in or relating to the production of protoxides and oxides or of hydro-protoxides and hydroxydes from metallic anodes by electrolysis of alkaline salt solutions." O. C. Strecker and H. H. Strecker. Dated November 17th. (*Complete.*)

26,935. "Improvements in or relating to apparatus for indicating and registering variations of insulation resistance in electric networks and circuits generally." A. J. Boult. (M. Travailleur, Belgium.) Dated November 17th. (*Complete.*)

26,986. "Electric trembling interruptor." E. Ducretet. Dated November 18th.

27,021. "Improvements in brushes for dynamo and electric motors." C. P. Elieson and W. S. Naylor. Dated November 18th.

27,022. "Improvements in accumulator boxes." C. P. Elieson and W. S. Naylor. Dated November 18th.

27,120. "Improvements in or connected with apparatus for electrically illuminating and displaying letters, numerals, devices and the like for advertising and decorative purposes." T. P. Martin. Dated November 19th. (*Complete.*)

27,122. "The spiral incandescent electric lamp." A. Collier. Dated November 19th.

27,129. "A new or improved electrolytic method of and apparatus for saponification." A. L. C. Nodon, L. A. Bretonneau and P. D'Alton Shee. Dated November 19th. (*Complete.*)

27,130. "Improvements in electrically illuminated signs." C. B. King, jun. Dated November 19th.

27,145. "Improvements relative to the sun compass for rendering it suitable as correction apparatus directly connected with the magnetic compass." C. N. Etirem. Dated November 19th. (*Complete.*)

27,153. "Improvements in boxes and fittings for electrical conduits." W. R. Comings. Dated November 19th.

27,156. "A method of renewing incandescent electric lamps." S. Z. de Ferranti and J. Atherton. Dated November 19th.

27,165. "Improvements in electrical storage batteries or accumulators." J. W. Townsend. Dated November 19th.

27,178. "Improvements in dynamo brushes." W. M. Mordey. Dated November 19th.

27,183. "Improvements in lightning arresters and cut-outs applicable to telegraph apparatus." C. Branzell, C. Ellison, S. G. Peterson, A. Fridstrom, J. Sundell, Monsos & Larson, A. C. Anderson, and W. Nystrom. Dated November 20th.

27,208. "Improvements in ceiling roses and similar fittings for electric light service." A. E. Tanner. Dated November 20th.

27,261. "Improvements in cover caps and lids for closing the entrances of gas sewers, telephone, and electrical supply shafts and holes, gullies, and the like." J. Price and J. Johnson. Dated November 20th.

27,271. "Improvements in holders for electric glow lamps." H. C. Gover and C. F. Proctor. Dated November 20th.

ELECTRICAL PATENTS OF 1883, EXPIRING IN DECEMBER, 1897.

We are informed by Messrs. W. P. Thompson & Co., that about 65 applications for electrical patents were filed in the month of December, 1883. Out of these applications some were not completed, and of those that were only four have been allowed to run their full length of term, viz, 14 years, and being of considerable interest we give short abstracts of them below.

5,676. "Improvements in the mariner's compass and in the means for ascertaining and correcting its errors.' Sir William Thomson. Dated December 8th, 1883. Relates to magnetic compasses. In place of an azimuth mirror a totally reflecting prism is employed, mounted in a frame supported in bearings secured to the body of the instrument. The shaft to which the frame is attached is pressed into its bearings by a spring. By this means bearings may be taken viewing the objectly or by reflection in the prism. An eccentric lens is arranged so as to facilitate the adjustment of the instrument. The instrument may also be arranged to admit of the use of two lenses differing in focal length for use in taking the bearings of celestial objects, or objects on the horizon. Each degree on the card has its number inverted so that the figure will be seen correctly when using the azimuth mirror while large figures mark the divisions for use in steering. For correcting, two vertical rows of fore-and-aft magnets are used, one on each side of the centre of the binnacle, and alternating with these a single row of thwart ship magnets, A revolving metal shutter closes in the magnets and is secured by means of a rod passing through staples and fastened by a padlock, or any other suitable means may be employed. An additional receptacle is employed for holding quicklime for the purpose of keeping the air inside dry. 4 claims.

5,682. "Improvements in magnets and dynamo electric machines with continuous currents." A de Menson and H. Cuenod. Dated December 8th, 1883. The objects of this invention are: (*a*) to remedy the great axial speed at which these machines require to be driven; (*b*) to increase the tangential speed of machines; (*c*) and prevent sparking at the commutator. A drum armature is covered with electric conducting wires placed longitudinally and parallel to the axis: the parallel wires are connected together through other wires, each forming a chord of the circumference of the base of the drum, each chord is an even number of parts of the circumference. The wires are all collected together so as to form a single endless conductor. The collecting brushes are the same in number as the divisions of the armature. The field magnet is polygonal, the number of sides of the polygon is "equal to the denominator of the fraction adopted for the windings of the armature." The pole pieces are at the angles of the polygon, and, as a whole have a cylindrical shape internally surrounding the drum. Another part of the invention consists of a brush holder in which the brushes touch the commutator by one of their ends; they are pivoted upon the centre from which the curve of the brush is described. Thus during the wear of the brush its point of contact with the commutator is not displaced. 1 claim.

5,718. "Improvements in the means for working and interlocking railway signals." S. C. Currie and I. A. Timmis. Dated December 12th, 1883. Relates to the interlocking of railway signals and points one with another, and also with any other switches and levers working signals or points by electrical means or by the combination of electrical and mechanical means in conjunction with a continuous working current substantially as described. 4 claims.

5,978. "Improvements in the manufacture of carbons for incandescent electric lamps." J. W. Swan. Dated December 31st, 1883. Relates to producing thin carbon filaments of uniform section and homogeneous texture for use in incandescent electric lamps. A plastic mass of carbonisable material such as nitrocellulose in acetic acid or other solvent, or nitro-glucose rendered plastic by heat is placed in a vessel and forced through discs, the filaments obtained being allowed to drop into alcohol or other liquid capable of causing the issuing filament to set. The filament is next treated with a solution of hydro-sulphate of ammonia and then washed dried and carbonised. 4 claims.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., *price, post free,* 8½*d.* (*in stamps*).]

1896.

13,730. "Improved solenoid for electric arc lamps." M. Badmer. Dated June 22nd, 1896. Arc lamps. The carbon holders are suspended by a cord passed over a pulley, and the upper holder is attached to a vertically sliding frame, the lower part of which consists of two iron cores extending half-way through tapered solenoids arranged oppositely, and connected in series with the arc as illustrated. This arrangement is stated to give a uniform pull on the pair of cores. The arc is struck and regulated by the direct action of the solenoids.